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**Key to Nearctic Parasites of the Genus *Rhyacionia*:  
with Species Annotations**

**by**

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## Key to Nearctic Parasites of the Genus *Rhyacionia*: with Species Annotations

by

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### INTRODUCTION

With the increasing interest being shown in the biological control of forest insect pests, it seemed that a comprehensive review of the parasites of the entire genus *Rhyacionia* would be timely. Members of this genus, commonly known as tip moths or shoot moths, are primarily pests in pine plantations. They may reduce growth increment and, in some cases, affect tree form so adversely that the tree is rendered unmerchantable for possible future sawtimber.

For years *Rhyacionia* spp. have been a problem mainly in the Eastern United States and Canada. In 1959, however, the European pine shoot moth, *R. buoliana* (Schiffermüller), was found in the state of Washington. Presently, nearly all the Forest Experiment Stations of the U. S. Forest Service are conducting some research on the genus *Rhyacionia*. In addition, a number of universities, particularly in the South, are carrying out research programs on tip moths and shoot moths. Several Canadian forest biology laboratories are conducting studies on general biology and on parasite behavior, and a comprehensive program of parasite introduction and establishment is underway.

Published reports list more than 100 insect species as parasites of the genus *Rhyacionia* in the Nearctic Region. An additional 27 parasite species noted in the literature are considered erroneous citations or questionable.

In 1927, Cushman(41) published a key to 29 parasite species of the Nantucket pine tip moth, *R. frustrana* (Comstock). While adequate at the time, this key falls far short as a taxonomic tool when the more than

100 species presently recorded are considered.

A more recent key to the parasites of *R. buoliana* in Wisconsin has been published (124). Keys to both adults and final-instar larvae are presented for 20 shoot moth parasites. The value of this regional work is enhanced by parasite larval descriptions, illustrations, and excellent detailed notes on biology.

Generic synonymy for the genus *Rhyacionia* includes *Evetria* and *Retinia*. Host citations may be listed under any of these names. The following species of *Rhyacionia* are found within the Nearctic Region and are considered in this study of the parasites.

<u>Scientific Names</u>	<u>Common Names</u>
<i>Rhyacionia adana</i> Heinrich	—
<i>R. buoliana</i> (Schiffenmüller)	European pine shoot moth
<i>R. busckana</i> Heinrich	—
<i>R. frustrana</i> (Comstock)	Nantucket pine tip moth
<i>R. frustrana</i> var. <i>bushnelli</i> (Busck)	Western pine tip moth
<i>R. montana</i> (Busck)	—
<i>R. neomexicana</i> (Dyar)	Southwestern pine tip moth
<i>R. pasadenana</i> (Kearfott)	Monterey pine tip moth
<i>R. rigidana</i> (Fernald)	Pitch-pine tip moth
<i>R. subtropica</i> Miller	Subtropical pine tip moth
<i>R. zozana</i> (Kearfott)	Ponderosa pine tip moth

Several parasite citations for *Rhyacionia*, *Retinia* and *Evetria* have been omitted since host species within these genera have subsequently been placed in other genera. These include *Rhyacionia comstockiana* (103), *Evetria comstockiana* (27), and *Retinia? comstockiana* Fernald (30) [= *Petrova comstockiana* (Fernald)]; *Evetria siskiyouana* Busck (40) [= *Barbara colfaxiana* var. *siskiyouana* (Kearfott)]; and *Evetria taxifoliella* Busck (40) [= *Barbara colfaxiana* var. *taxifoliella* (Busck)].

A loose format has been maintained throughout this paper to permit addition of notes and information published in future papers on this subject. This should greatly enhance the usefulness of this paper to the worker in biological control.

#### List of Parasite Species

The synoptic list of Nearctic or successfully introduced parasites is constructed, with a few exceptions, solely from published papers. No attempt has been made to include citations found in the various progress reports, theses, insect identification forms, etc.

Both parasites and hyperparasites are listed. The true relationships of these insects to *Rhyacionia*, when known, are discussed in the annotated species list.

The parasite list is arranged phylogenetically through genus according to Muesebeck *et al.* (104), Krombein (79), and Stone *et al.* (120). Species within a genus are arranged alphabetically.



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ORDER

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## Superfamily

## Family

## Subfamily

## Tribe

---

Genus — species

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Specific nomenclature conforms to the above references except for a few cases where more recent changes were suggested by taxonomists of the U. S. National Museum. Incorrect literature citations (synonyms, misspellings, etc.) are not indicated in this list but they are presented in the annotated species lists and the index.

Parasite Keys

These keys are designed for the entomologist and require some knowledge of insect anatomy. Workers using the keys will find Torre-Bueno(125) a useful reference. Some key characters are illustrated by line drawings or wing photographs and referred to in key couplets by figure number.

All parasites or genera listed in the synoptic list are included in these dichotomous keys. For simplicity, I have chosen to divide the key into different taxonomic levels. The first key goes to order and family, and then succeeding keys go to subfamily, tribe, genus, and species. In some cases, depending on the size of the group, keying to family (e.g., Elasmidae) is all that is necessary to determine the parasite species. In other instances, each level of key must be used in order to make specific determination.

At the end of each key couplet is found the number of the next couplet to go to within that key. In instances where a couplet gives a determination to order, family, subfamily, tribe, or genus, the number following that intermediate determination refers to the page where this group may be keyed further. When a specific (in some cases generic) determination is made, the page number refers to the page where the literature is abstracted in the annotated species list.

All keys were developed from published keys or personal correspondence with taxonomists, and the key characters were checked for accuracy with verified specimens provided by the U. S. National Museum or other authoritative sources.

In some instances species keys are quite difficult to work with even for the expert and occasionally both sexes are necessary for positive identification. In most cases, accurate generic determination should be possible by the entomologist, but species determinations, particularly with some of the large genera, may be difficult and require the assistance of an expert.

One limitation of this key (a characteristic of all keys) is that it

will not detect a new species of parasite.

Workers studying parasites of this genus are cautioned that collecting and placing *Rhyacionia* infested shoots in a closed container is not a reliable means of parasite collection. Parasites of pine-needle miners, spiders, or insects alighting on pine shoots (and captured during shoot collection) may also be collected and be erroneously associated with *Rhyacionia*. In addition, their true relationship; e.g., primary vs. secondary, solitary vs. gregarious; is not always apparent.

This technique does have value in determining the presence and abundance of verified parasite species in a particular area, but any new species should be viewed with skepticism and attempts should be made to make collections from actual host material.

#### Annotated Parasite Species List

The annotated parasite species list includes information on nomenclatural literature records, adult size, range, *Rhyacionia* hosts, and general annotations.

Published *Rhyacionia* parasites considered erroneous are mentioned and discussed preceding each family. The decisions as to whether the citations are erroneous are largely those of personnel at the U. S. National Museum.

Misspellings, synonyms, and erroneous combinations of each species of parasite are presented only if thus listed in the *Rhyacionia* literature. In some cases, nomenclature found in the literature has been recently changed to new generic or specific names. The index includes all such literature records of synonyms, misspellings, and erroneous combinations.

The parasite ranges are based on those published in the various synoptic catalogs, and they also include States where parasites were reared from *Rhyacionia* material. This not only gives information on the parasites' total range, but also areas where it has been found attacking the genus *Rhyacionia*.

In the "annotations" section, I have briefly abstracted published information regarding each parasite. Only published manuscripts concerning *Rhyacionia* have been abstracted. In most cases, only what is available in the citation is given, and additional perusal of the original manuscript will be required to obtain details of the study or observation. Much additional information on each parasite may be found in other papers cited in the various synoptic catalogs or manuscript bibliographies.



LIST OF PARASITE SPECIES

ORDER HYMENOPTERA

Superfamily Ichneumonoidea

Braconidae

Euphorinae

*Meteorus* sp. prob. *hyphantriae* Riley

Macrocentrinae

*Macrocentrus ancyllivorus* Rohwer

*M. cuniculus* Walley

*M. instabilis* Muesebeck

Blacinae

*Orgilus obscurator* (Nees)

Agathidinae

*Earinus zeirapherae* Walley

*Agathis acrobasis* (Cushman)

*A. annulipes* (Cresson)

*A. binominata* Muesebeck

*A. pini* (Muesebeck)

Microgasterinae

*Apanteles bushnelli* Muesebeck

*A. epinotiae* Viereck

*A. petrovae* Walley

*Microgaster epagoges* Gahan

Cheloninae

*Phanerotoma rhyacioniae* Cushman

*Ascogaster* sp.

*Chelonus* sp.

Braconinae

*Bracon gelechiae* Ashmead

*B. gemmaecola* (Cushman)

*B. hebetor* Say

*B. mellitor* Say

*B. politiventris* (Cushman)

*B. rhyacioniae* (Muesebeck)

*B. variabilis* (Provancher)

Ichneumonidae

Pimplinae

Ephialtini

*Scambus* (*Ateleophadnus*) *pterophori* (Ashmead)  
*S.* (*Scambus*) *aplopappi* (Ashmead)  
*S.* (*S.*) *buoliana* (Hartig)  
*S.* (*S.*) *hispae* (Harris)  
*S.* (*S.*) *tecumseh* Viereck  
*S.* (*S.*) *tenebrosus* Walley

*Exeristes comstockii* (Cresson)

*Dolichomitus pterelas* (Say)  
*D. terebrans nubilipennis* (Viereck)

Pimplini

*Pimpla annulipes* Brullé  
*P. hesperus* (Townes)  
*P. sanguinipes* Cresson  
*P. turionellae* (Linnaeus)

*Itoplectis conquisitor* (Say)  
*I. evetriae* Viereck  
*I. quadricingulatus* (Provancher)

Ichneumoninae

*Phaeogenes epinotiae* Cushman  
*P. hebrus* (Cresson)

Lissonotinae

Glyptini

*Glypta varipes* Cresson

Lissonotini

*Pimplopterus parvus* (Cresson)

Ophioninae

Campoplegini

*Campoplex frustranae* Cushman

*Diadegma* sp.

Cremastini

*Pristomerus baumhoferi* Cushman

*Trathala retiniae* (Cresson)

*Temelucha epagoges* (Cushman)  
*T. evetriae* (Cushman)  
*T. interruptor* (Gravenhorst)  
*T. minor* (Cushman)  
*T. rhyacioniae* (Cushman)

Anomalini

*Atrometus clavipes* (Davis)  
*A. evetivorus* (Rohwer)

Superfamily Chalcidoidea

Trichogrammatidae

*Trichogramma minutum* Riley

Eulophidae

Eulophinae

*Dicladocerus* sp.

Tetrastichinae

*Tetrastichus coerulescens* Ashmead  
*T. longicarpus* (Girault)  
*T. marylandensis* (Girault)  
*T. turionum* (Hartig)

Elachertinae

*Paraolinx taedae* Miller

*Elachertus pini* Gahan  
*E. sp. nr. proteoteratis* Howard

*Hyssopus rhyacioniae* Gahan  
*H. thymus* Girault

Entedontinae

*Euderus argyresthiae* (Crawford)  
*E. subopacus* (Gahan)

Elasmidae

*Elasmus setosiscutellatus* Crawford

Encyrtidae

*Copidosoma geniculatum* (Dalman)

Eupelmidae

*Eupelmus cyaniceps amicus* Girault  
*E. cyaniceps cyaniceps* Ashmead

*Eupelmella vesicularis* (Retzius)

*Encyrtaspis californica* (Ashmead)

Perilampidae

*Perilampus fulvicornis* Ashmead  
*P. hyalinus* Say  
*P. tristis* Mayr

Torymidae

*Monodontomerus dentipes* (Dalman)  
*M. minor* (Ratzeburg)

Pteromalidae

*Catolaccus aeneoviridis* (Girault)

*Dibrachys cavus* (Walker)

*Habrocytus phycidis* Ashmead  
*H. thyridopterigis* Howard

Eurytomidae

*Eurytoma pini* Bugbee

Chalcididae

Haltichellinae

*Haltichella rhyacioniae* (Gahan)  
*H. xanticles* (Walker)

Chalcidinae

*Spilochalcis flavopicta* (Cresson)  
*S. leptis* Burks

Superfamily Bethyloidea

Bethylidae

*Goniozus columbianus* Ashmead  
*G. electus* Fouts  
*G. foveolatus* Ashmead  
*G. longiceps* Kieffer  
*G. longinervis* Fouts

ORDER DIPTERA

Superfamily Chloropoidea

Chloropidae

*Hapleginella conicola* (Greene)

Superfamily Oestroidea

Tachinidae

Tachininae

*Lypha dubia* (Fallén)

Goniinae

Blondeliini

*Lixophaga mediocris* Aldrich

*L. plumbea* Aldrich

*Urophyllopsis retiniae* (Coquillett)

Siphonini

*Actia nudibasis* Stein

Hyperecteiniini

*Erynnia tortricis* (Coquillett)

Winthemiini

*Nemorilla floralis* (Fallén)

Eryciini

*Madremyia saundersii* (Williston)

# PARASITE KEYS

## Key to Orders and Families of Recorded Nearctic Parasites of the Genus *Rhyacionia*

1. Two pair of wings..... Hymenoptera (2)
- 1'. One pair of wings..... Diptera (14)
- 2(1). Antennae filiform, not elbowed, with 16 or more segments; front wings with venation well developed; well-defined stigma (Figs. 1a, 2a)..... Ichneumonoidea (3)
- 2'. Antennae with less than 14 antennal segments..... 4
- 3(2). Front wing with 1 recurrent vein (Fig. 1a)..... Braconidae (11 genera) p. 12
- 3'. Front wing with 2 recurrent veins (Fig. 2a)..... Ichneumonidae (14 genera) p. 18
- 4(2'). Wing venation greatly reduced, no closed cells in front wing (Fig. 3a), antennae elbowed, pronotum not extending to tegulae..... Chalcidoidea (5)
- 4'. Front wings with closed median cell (Fig. 3e), antennae not elbowed, pronotum extending to tegulae..... Bethyloidea (1 genus) p. 30
- 5(3'). Tarsi 3-segmented; wing pubescence arranged in rows, postmarginal vein absent; very minute insect..... Trichogrammatidae (1 genus) p. 80
- 5'. Tarsi 4- or 5-segmented; wing pubescence not in rows; size variable..... 6
- 6(5). Axillae extending cephalad to or beyond tegulae; apical spur on front tibiae small and straight; tarsi 4-segmented; antennae usually with 9 or fewer segments..... 7
- 6'. Axillae not extending cephalad to or beyond tegulae; apical spur of front tibia large and curved; tarsi 5-segmented; antennae variable..... 8
- 7(6). Hind coxae huge, triangular, usually disc-like and flattened; marginal vein usually greatly elongated; tarsi very long; very small, usually blackish insects..... Elasmidae (1 genus) p. 87
- 7'. Hind coxae normal, not enlarged; marginal vein not greatly elongated; tarsi of normal length..... Eulophidae (6 genera) p. 25



- 8(6'). Mesopleura large and convex, usually without a femoral groove, axillae usually meeting at their inner angles; apical spur of middle tibia usually very large and stout..... 9
- 8'. Mesopleura with a groove for the reception of the femora; apical spur of middle tibia normal, not enlarged..... 10
- 9(8). Mesonotum more or less convex; marginal vein shorter than sub-marginal vein..... Encyrtidae (1 genus) p. 88
- 9'. Mesonotum flattened or concave; marginal vein as long as sub-marginal vein..... Eupelmidae (3 genera) p. 27
- 10(8'). Hind femora robustly enlarged, and toothed beneath; hind tibia arched..... Chalcididae (2 genera) p. 29
- 10'. Hind femora not enlarged, either not toothed beneath or with only one or two teeth..... 11
- 11(10'). Hind coxae considerably larger (3 times) than front coxae; body metallic in color..... Torymidae (1 genus) p. 29
- 11'. Hind coxae little if any larger than front coxae..... 12
- 12(11'). Pronotum wide, more or less quadrate, as wide as mesonotum (Figs. 4b, 4c); mesonotum usually very coarsely sculptured..... 13
12. Pronotum somewhat conical and much narrowed in front (Fig. 4a); mesonotum usually finely sculptured..... Pteromalidae (3 genera) p. 29
- 13(12). Pronotum short, wider than long (Fig. 4c); abdomen transversely convex, the second tergite (or the fused second and third tergites) covering most of its surface; thorax very robust; metallic insects..... Perilampidae (1 genus) p. 28
- 13'. Pronotum more or less quadrate, about as long as wide (Fig. 4b); abdomen of female rounded or ovate, more or less compressed, the second tergite never very large; thorax of more normal proportions, coarsely punctate; black not metallic..... Eurytomidae (1 genus) p. 95
- 14(1'). Second antennal segment with a longitudinal seam along upper outer side; thorax with a complete transverse suture; lower calyptera large..... Tachinidae (7 genera) p. 31
- 14'. Second antennal segment without such a seam; thorax without a complete transverse suture; lower calypter small or rudimentary..... Chloropidae (1 genus) p. 103

ORDER HYMENOPTERA

Family Braconidae

Key to Subfamilies

1. Clypeus semicircularly emarginate below, and forming with the mandibles a more or less circular opening or cavity (Fig. 4e) ..... Braconinae (1 genus) p. 15
- 1'. Clypeus not emarginate below, or at most with a broad shallow emargination, not forming such an opening with the mandibles (Fig. 4d) ..... 2
- 2(1'). Abdominal tergites separated by distinct sutures, and all beyond the third distinctly movable; if rarely all are fused, the abdomen is strongly clavate ..... 3
- 2'. Abdominal tergites fused to form a rigid dorsal shell or carapace, may have sutures but *all* segments are immovable, abdomen never petiolate, front wing with 2 intercubiti (Figs. 1d, 1i) ..... Cheloninae (3 genera) p. 15
- 3(2). Abdomen sessile or subsessile ..... 4
- 3'. Abdomen petiolate ..... Euphorinae (1 genus) p. 50
- 4(3). Radial cell either very narrow, or incompletely formed with the radial vein weak or wanting apically; second cubital cell when present usually small or imperfectly formed (Figs. 1e, 1g) ..... 5
- 4'. Radial cell never much narrowed; second cubital cell when present large and fully formed (Figs. 1f, 2c) ..... 6
- 5(4). Radial cell of forewing narrow, the radial vein almost always distinct to the tip (Fig. 1e) ..... Agathidinae (2 genera) p. 13
- 5'. Radial cell incompletely formed, more or less incomplete apically (Fig. 1g) ..... Microgasterinae (2 genera) p. 14
- 6(4'). Front wing with 1 intercubitus (Fig. 1f) ..... Blacinae (1 genus) p. 52
- 6'. Front wing with 2 intercubiti (Figs. 2c, 2d) ..... Macrocentrinae (1 genus) p. 13

Subfamily Macrocentrinae

Genus *Macrocentrus* (101)

Key to Species

1. Submedian cell always closely hairy (Fig. 2c), never glabrous at apex; apical teeth of trochanters, especially of anterior legs, very weak, indistinct; stigma never uniformly pale yellow; small, slender species that are apparently all gregarious parasites..... *cuniculus* p. 51
1. Submedian cell weakly hairy apically (Fig. 2d), usually with a distinct hairless area at apex, rarely uniformly hairy, and then the apical teeth of trochanters distinct, or the stigma uniformly pale yellow; apparently all solitary parasites..... 2
- 2(1'). Maxillary palpus with longest segment not distinctly longer than second segment of antennal flagellum; stigma brown with a conspicuous pale spot at base, or yellow with a distinct cloud in apical half; abdomen varying from entirely testaceous to more or less blackish at base and apex, but second and third tergites always entirely pale, second tergite not distinctly longer than broad at apex; usually smooth apically, male scape not swollen ..... *ancylivorus* p. 50
- 2'. Maxillary palpus with longest segment usually longer than second segment of antennal flagellum; stigma most frequently uniformly brown or yellow; usually second and third tergites more or less blackish as well as the first and sometimes the following in part; second tergite most frequently longer than broad and usually completely aciculate, male scape swollen..... *instabilis* p. 51

Subfamily Agathidinae

Key to Genera

1. First cubital cell completely separated from the first discoidal cell by the cubital vein (Fig. 2e)..... *Earinus* (1 species) p. 53
- 1'. First cubital cell confluent with the first discoidal cell, cubital vein not complete between these cells (Fig. 1e)..... *Agathis* (4 species) p. 14

## Genus *Agathis*

### Key to Species

- 1. First abdominal tergite with two more or less prominent widely separated dorsal longitudinal keels which arise at the outer margin of the basal impression and extend posteriorly (Fig. 41); abdomen always red or testaceous; anterior and middle legs nearly always mostly black or blackish; parapsidal furrows more often smooth than foveolate, sometimes very weak or even wanting; wings usually dark..... 2
- 1'. First abdominal tergite rarely with such dorsal longitudinal keels, anterior and middle legs very rarely black beyond the trochanters, abdomen usually black; parapsidal furrows usually sharply impressed and finely foveolate or punctate; wings often hyaline or nearly..... *annulipes* p. 54
- 2(1). Posterior coxae, trochanters, and femora uniformly reddish testaceous;..... 3
- 2'. Posterior trochanters, usually at least the base of the hind femora and more or less of the hind coxae, black or blackish ..... *binominata* p. 54
- 3(2). Metapleuron mostly rugose, tegulae usually black..... *pini* p. 54
- 3'. Without complete rugose metapleuron, tegulae usually not black ..... *acrobasis* p. 53

## Subfamily Microgasterinae

### Key to Genera

- 1. Second cubital cell open behind, the second intercubitus entirely wanting (Fig. 1c)..... *Apanteles* (3 species) p. 14
- 1'. Second cubital cell not confluent with third, the second intercubitus present, though more or less hyaline (Fig. 1g)..... *Microgaster* (1 species) p. 57

## Genus *Apanteles*

### Key to Species

- 1. Propodeum with a distinct median longitudinal depression..... 2
- 1'. Propodeum without a distinct median longitudinal depression.... *petrovae* p. 56

- 2(1). Posterior polished area on the lateral face of the scutellum large, triangular in shape, and extending almost to the base of the scutellar disc; tegulae always yellowish or transparent-whitish..... *epinotiae* p. 56
- 2'. Posterior polished area on the lateral face of the scutellum much smaller, usually semicircular in shape, and rarely extending half way toward base of scutellar disc along the side of the latter..... *bushnelli* p. 55

#### Subfamily Cheloninae

##### Key to Genera

1. First cubital and first discoidal cells separated, not confluent; eyes bare (Fig. 1d)..... 2
- 1'. First cubital and first discoidal cells confluent, the first abscissa of the cubitus absent or incomplete; abdomen not segmented; eyes hairy (Fig. 1i)..... *Chelonus* (1 species) p. 58
- 2(1). Abdomen not segmented..... *Ascogaster* (1 species) p. 57
- 2'. Abdomen 3-segmented..... *Phanerotoma* (1 species) p. 57

#### Subfamily Braconinae

##### Genus *Bracon*

##### Key to Species (98)

1. Mesoscutum and scutellum more or less, the lateral face of pronotum, the meso- and the meta-pleura, propodeum and posterior coxae minutely closely punctate or reticulate, opaque..... *gelechiae* p. 58
- 1'. Mesoscutum, scutellum, lateral face of pronotum mostly, and mesopleura smooth and polished..... 2
- 2(1'). Second abscissa of radius not or scarcely longer than the first abscissa, not longer than first intercubitus and hardly one-third as long as third abscissa of radius (Fig. 1b); mesonotal lobes pubescent; antennae stout, tapering to the tip, the female antennae 13- to 19-segmented and not extending beyond the apex of the thorax; ovipositor sheaths hardly half as long as the abdomen..... *hebetor* p. 60
- 2'. Second abscissa of radius much longer than the first abscissa, longer than first intercubitus, and very rarely less than half as long as third abscissa of radius (Figs. 1h, 1j); mesonotal lobes usually bare, the pubescence nearly always restricted to the region of the parapsidal furrows; female antennae not as above..... 3



- 3(2'). Females..... 4
- 3'. Males..... 9
- 4(3). Dorsum of abdomen mostly smooth and polished, the sculpture when present restricted to the three basal tergites, only rarely occurring on the third; the sculpture on second and third tergites when present usually in the form of longitudinal striae and restricted to the middle two-thirds of the tergite; propodeum mostly or entirely smooth and polished; frons usually smooth and polished, if sculptured, the face and coxae are black; face rarely yellow; if so, the abdomen, including first and second tergites, is entirely smooth and polished..... 5
- 4'. Dorsum of abdomen sculptured, although sometimes very minutely so, over most of its surface; very rarely not distinctly sculptured beyond second tergite, but then the latter is entirely finely granular, the frons is finely reticulately sculptured and the face and the coxae are yellow; face and coxae very rarely black; if so, then abdomen is distinctly sculptured over nearly its entire surface..... 6
- 5(4). Ovipositor sheaths protruding at least very nearly the length of the abdomen, sometimes much longer.....  
..... *rhyacioniae* p. 60
- 5'. Ovipositor sheaths protruding not more than half the length of its abdomen beyond its apex.....  
..... *politiventris* p. 60
- 6(4'). Ovipositor sheaths at most as long as the abdomen beyond first tergite..... 7
6. Ovipositor sheaths as long as the abdomen or longer.....  
..... 8
- 7(6). Antennae normally 23- to 29-segmented, shorter than the body, the segments of apical half of flagellum but little longer than wide, second abdominal tergite usually as long as the first and longer than the third; malar space very nearly as long as first flagellar segment; propodeum usually punctate over its posterior half..... *gemmacola* p. 59
- 7'. Antennae usually as long as the body, the flagellar segments much longer than broad; second abdominal tergite usually shorter than the first and scarcely as long as the third.....  
..... *variabilis* p. 61



- 8(6'). Second abscissa of discoideus as long as the recurrent vein (Fig. 1j); wings somewhat fuscous, the stigma yellow; abdomen strongly granular above, the second tergite more or less rugulose; suturiform articulation rather broad, foveolate, and somewhat arcuate, the second tergite somewhat emarginate behind; flagellar segments of antennae rather stout, most of them a little longer than broad; malar space about as long as first flagellar segment..... *mellitor* p. 59
- 8'. Second abscissa of discoideus not as long as the recurrent vein (Fig. 1h); otherwise not agreeing completely with the above..... *variabilis* p. 61
- 9(3'). Dorsum of abdomen mostly smooth and polished, the sculpture when present very rarely extending to the third tergite; propodeum smooth and polished, sometimes with a median carina or a stub of a median ridge at apex; frons usually smooth and polished; if sculptured, the face and coxae black; face very rarely yellow; if so, then the abdomen is entirely smooth and polished..... 10
- 9'. Dorsum of abdomen mostly sculptured; very rarely not distinctly sculptured beyond second tergite, but then frons is finely reticulately sculptured and face and coxae are yellow; face and coxae very rarely black and then abdomen is distinctly sculptured..... 11
- 10(9). Frons entirely, and usually the vertex to some extent, closely minutely punctate or reticulate and opaque; parapsidal grooves completely thickly hairy; head black with contrasting yellow orbital lines; thorax short and stout, black; wings rather strongly infuscated..... *politiventris* p. 60
- 10'. Frons usually smooth and polished, rarely with faint sculpture just above insertion of antennae; at least not exactly as above..... *rhyacioniae* p. 60
- 11(9'). Propodeum faintly reticulate on its posterior half; sometimes more distinctly granular over its entire surface; thorax never wholly black..... *germaecola* p. 59
- 11'. Propodeum smooth and polished, with no indication of such reticulations..... 12
- 12(11'). Distance between clypeal foveae more than twice as long as malar space; antennae usually 24- to 32-segmented, very rarely with 33 or 34 segments..... *variabilis* p. 61
- 12'. Distance between clypeal foveae not distinctly twice as long as malar space; or, if apparently as long, then with antennae 24- to 40-segmented; antennae rarely with less than 33 segments..... *mellitor* p. 59

# Family Ichneumonidae

## Key to Subfamilies

1. First abdominal segment petiolate, not much wider than deep at base; spiracles usually at middle or behind..... 2
- 1'. First abdominal segment sessile, much wider basally than deep; spiracle at or before the middle..... 4
- 2(1). Petiole bent or elbowed at the spiracles (use ventral outline of petiole) (Fig. 5c); ovipositor without apical notch; areolet of forewing pentagonal (sometimes pentagonal in position); sometimes with only one distinct cubitus..... 3
- 2'. Petiole straight not elbowed or bent at spiracles (use ventral line of petiole) (Fig. 5a); ovipositor with apical notch; areolet of forewing not pentagonal but oblique, triangular or missing..... Ophioninae (3 tribes) p. 23
- 3(2). Spiracles of petiole nearer apex of petiole than to each other; sternauli absent or superficial..... Ichneumoninae (1 genus) p. 23
- 3'. Spiracles of petiole closer to each other than to apex of petiole; sternauli distinct..... Cryptinae (See page 62)
- 4(1'). Clypeus strongly convex; first abdominal segment (dorsally) usually a little wider at apex than at base, and viewed laterally without a distinct glymma or groove at base; ovipositor with an apical notch..... Lissonotinae (2 tribes) p. 23
- 4'. Clypeus flat or concave, often emarginate apically; first abdominal segment (dorsally) not or only slightly wider at apex than at base, and viewed laterally with a distinct glymma or groove at base; ovipositor without an apical notch but often with ridges at apex..... Pimplinae (2 tribes) p. 19

Subfamily Pimplinae

Key to Tribes (129)

1. Mesopleural suture not angulated near the middle (Fig. 5h), when hind tibia is banded there are apical and basal dark bands and a median pale band, the extreme base thus being dark..... Pimplini (2 genera) p. 21
- 1'. Mesopleural suture angulate near the middle (Fig. 5i); when hind tibia is banded there are usually apical and subbasal dark bands and median and basal pale bands, the extreme base thus being pale..... Ephialtini (3 genera) p. 19

Tribe Ephialtini

Key to Genera (129)

1. Nervellus (Fig. 2b) broken at or below the middle (Fig. 2f)..... Scambus (6 species) p. 19
- 1'. Nervellus (Fig. 2b) broken near or above the middle (Fig. 2g).... 2
- 2(1'). Second tergite with long, strong, oblique basolateral grooves, (Fig. 5f); first tergite rather long, usually about as long as second tergite..... Dolichomitus (2 species) p. 21
- 2'. Second tergite without oblique basolateral grooves or with relatively short and weak grooves; first tergite rather short, usually much shorter than second tergite..... Exeristes (1 species) p. 66

Genus Scambus

Keys to Subgenera and Species (129)

(Separate Keys to Males and Females)

Males

1. Front femur with a single, broad, distinctly coriaceous excision beneath; front tibia rather strongly angularly bent near middle, and rather strongly swollen in apical 0.6; scape mostly, or entirely, brownish or blackish beneath (subgenus *Ateleophadnus*)..... pterophori p. 62
- 1'. Front femur entire or with a single or double excision beneath, the excision without distinct, coriaceous sculpture; front tibia moderately to very weakly, rather evenly bent, and not strongly swollen in apical 0.6; scape variable, frequently conspicuously whitish beneath (subgenus *Scambus*)..... 2

- 2(1'). Scape whitish beneath, except sometimes at the base..... 3
- 2'. Scape blackish beneath, except sometimes narrowly at the apex... 4
- 3(2). Front femur with a single excision beneath..... *hispae* p. 64
- 3'. Front femur with a double excision beneath..... *tecumseh* + *buolianae*<sup>1</sup> pp. 64 & 63
- 4(2'). Front femur without an excision beneath..... *tenebrosus* p. 65
- 4'. Front femur with a broad, deep oblique excision beneath..... *aplopappi* p. 63

#### Females

1. Ovipositor rather strongly compressed, with basalmost ridges on apex of lower valve forming an angle of about 40° with its longitudinal axis; propodeum rather long, with distinct, long, dorsomedial carinae diverging posteriorly; subgenital plate with a moderately large, median, basal, membranous excision; sheath about 0.7 times as long as abdomen; (subgenus *Ateleophadnus*).... *pterophori* p. 62
- 1'. Ovipositor rather weakly compressed, with basalmost ridges on apex of lower valve forming an angle of about 30° with its longitudinal axis; propodeum rather short, usually with rather short dorsomedial carinae; subgenital plate with a large, median basal, membranous excision; sheath at least 0.66 times as long as abdomen; (subgenus *Scambus*)..... 2
- 2(1'). All coxae dark reddish brown or blackish; head rather thick; temple not receding for some distance behind eye; propodeum without dorsomedial carinae..... *tenebrosus* p. 65
2. Middle and hind coxae reddish; head not especially thick; temple usually receding behind eye; propodeum usually with short, dorsomedial carinae..... 3

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<sup>1</sup> Males and females of *Scambus* (S.) *tecumseh* Viereck are not readily distinguishable from the successfully introduced European species *S.* (S.) *buolianae* (Ratzeburg) and may not be a distinct species.

- 3(1'). Front and middle tibiae with a conspicuous, pale stripe on upper side extending to apex; hind tibiae with pale annulus extending close to apex on upper side and beneath interrupted by a broad, fuscous stripe that joins the subbasal and apical annuli; tergites usually more or less reddish; hind angle of pronotum with a pale spot that usually extends forward as a short stripe along upper margin of pronotum..... *aplopappi* p. 63
- 3'. Front and middle tibiae with stripe on upper side usually less conspicuous and not extending to apex; hind tibia with pale annulus not extending close to apex on upper side and usually only narrowly or distinctly interrupted beneath; tergites without reddish markings; pale spot in hind angle of pronotum usually not produced as a short stripe along upper margin of pronotum... 4
- 4(3'). Trochanters of front legs reddish; palpi often more or less fuscous..... *tecumseh* + *buolianae*<sup>2</sup> pp. 64 & 63
- 4'. Trochanters of front legs whitish; palpi usually entirely whitish..... *hispae* p. 64

#### Genus *Dolichomitus*

#### Key to Species (129)

1. Males: clasper with a strong notch near the middle of its upper margin; nervellus broken near or a little above its middle. Females: dorsally projecting flange of lower valve of ovipositor with four or more closely spaced ridges..... *terebrans nubilipennis* p. 67
- 1'. Males: clasper without a strong notch near the middle of its upper margin; nervellus broken distinctly above its middle. Females: dorsally projecting flange of lower valve of ovipositor with two widely spaced ridges..... *pterelas* p. 67

#### Tribe Pimplini

#### Key to Genera (129)

1. Inner margin of eye not or weakly emarginate above antennal socket (Fig. 5d); female tarsal claws without a basal tooth.... *Pimpla* (4 species) p. 22
- 1'. Inner margin of eye strongly emarginate at antennal socket (Fig. 5e); female front tarsal claws usually with a large tooth..... *Itoplectis* (3 species) p. 22

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<sup>2</sup> *Ibid.*



## Genus *Pimpla*

### Key to Species (129)

1. Trochanters black except that second trochanter of hind leg may be fulvous; coxae black..... *turionellae* p. 69
- 1'. Trochanters fulvous, or rarely some of them black; coxae fulvous or sometimes black..... 2
- 2(1'). Hind femur with its apical 0.2± fuscous; hind tibia black with a distinct whitish band..... *annulipes* p. 68
- 2'. Hind femur entirely fulvous, or its apical 0.1± sometimes faintly infusate; hind tibia varying from entirely fulvous to black with a white band..... 3
- 3(2'). Males..... 4
- 3'. Females..... 5
- 4(3). Hind tibia uniformly fulvous with its apical 0.1± somewhat infusate; punctures on lower hind part of mesopleurum moderately coarse; their interspaces nearly always less than their diameter; front wings 5.4 to 9.0 mm long; second and fourth segments of maxillary palpus brown ..... *sanguinipes* p. 69
- 4'. Hind tibia usually more or less infusate with a more or less distinct paler band subbasally; punctures on lower hind part of mesopleurum rather fine, their interspaces about twice their diameter; front wing 3.7 to 4.7 mm long..... *hesperus* p. 68
- 5(3'). Epipleurum of second tergite very narrowly wedge-shaped, about 4.2 as long as wide..... *sanguinipes* p. 69
- 5'. Epipleurum of second tergite more broadly wedge-shaped, about 2.5 as long as wide..... *hesperus* p. 68

## Genus *Itoplectis*

### Key to Species

1. Abdominal tergites all black; coxae black..... *evetrieae* p. 71
- 1'. Abdominal tergites with a paler band on hind margin; coxae red.. ..... 2



- 2(1'). Band on hind margin of tergites white or whitish; apex of hind femur with apical 0.2± black or blackish.....  
 ..... *conquisitor* p. 70
- 2'. Band on hind margin of tergites usually tan, apex of hind femur without the apical 0.2± black or blackish.....  
 ..... *quadricingulatus* p. 71

#### Subfamily Ichneumoninae

##### Genus *Phaeogenes*

##### Key to Species

1. Abdomen ferruginous with black apex.....  
 ..... *hebrus* p. 72
- 1'. Abdomen entirely dark brown to black.....  
 ..... *epinotiae* p. 72

#### Subfamily Lissonotinae

##### Key to Tribes

1. Oblique furrows cutting off corners of abdominal tergites 2, 3, and 4 (Fig. 5g)..... Glyptini (1 genus) p. 73
- 1'. Oblique furrows absent from abdominal tergites.....  
 ..... Lissonotini (1 genus) p. 73

#### Subfamily Ophioninae

##### Key to Tribes

1. Whole propodeum (metapleura may be included also) with numerous (over 30) irregular areas set off by strong irregular ridges, the majority of which exceed in height 1.5 times the diameter of an eye facet (small rugosities may be present within these areas); profile of metapleura from dorsal view distinctly convex, not continuous with the lines formed by the sides of the mesothorax..... Anomalini (1 genus) p. 25
- 1'. Propodeum with about 13 (or fewer) areas set off by the usual propodeal carinae (the areas may contain rugosities of much shorter dimensions than the regular carinae) or, if covered with a network of small areas and ridges, the height of a great majority are not more than 1.0 times the diameter of an eye facet; profile of metapleura from dorsal view straight or nearly straight, and continuous or nearly continuous with the lines formed by the sides of the mesothorax..... 2

- 2(1'). Clypeus not distinctly separated from the face by a groove, no clypeal suture; face thickly pubescent..... Campoplegini (2 genera) p. 24
- 2'. Clypeus distinctly separated from the face by a groove, clypeal suture distinct; face not thickly pubescent..... Cremastini (3 genera) p. 24

#### Tribe Campoplegini

##### Key to Genera

1. Petiole with lateral suture (suture separating its dorsum from its sternum) at basal fourth closer to dorsal surface than to ventral surface, without a distinct pit in front of spiracle (Fig. 5a)..... *Campoplex* (1 species) p. 74
- 1'. Petiole with lateral suture (suture separating its dorsum from its sternum) at basal fourth closer to ventral surface than to dorsal surface, with a distinct pit in front of spiracle (Fig. 5b)..... *Diadegma* (1 species) p. 75

#### Tribe Cremastini

##### Key to Genera

1. Hind femur with a large tooth beneath; ovipositor crimped at apex..... *Pristomerus* (1 species) p. 75
- 1'. Hind femur without tooth; ovipositor not crimped at apex..... 2
- 2(1'). Petiole with ventral margins of tergite touching or nearly touching, never parallel; male genital clasper with a basal dorsal lobe..... *Temelucha* (5 species) p. 24
- 2'. Petiole with the ventral margins of tergite widely separated, parallel or nearly so; male genital clasper simple..... *Trathala* (1 species) p. 76

#### Genus *Temelucha*

##### Key to Species

1. Thorax testaceous or yellow, sometimes more or less black dorsally or ventrally..... *minor* p. 78
- 1'. Thorax black, sometimes with yellow markings dorsally or laterally..... 2
- 2(1'). Propodeum more or less roundly sloping to apex (Fig. 5k); mesoscutum shiny..... 3
- 2'. Propodeum not roundly but gradually sloping to apex (Fig. 5j); mesoscutum shagreened with fine punctures..... 4

- 3(2). Scutellum pale with dorsum more or less flat; size larger, body length 6.5 to 8 mm..... *interruptor* p. 77
- 3'. Scutellum all black with dorsum somewhat rounded; size smaller, body length 5 to 6 mm..... *evetriae* p. 78
- 4(2'). Scutellum yellowish with the dorso-lateral margins distinctly carinate at least to near the middle, sometimes complete and meeting apically..... *epagoges* p. 76
- 4'. Scutellum usually blackish or somewhat reddish with dorso-lateral margins carinate at most not beyond basal third..... *rhyacioniae* p. 78

#### Tribe Anomalini

#### Genus *Atrometus*

#### Key to Species

1. Neck of propodeum approximately as long as length of hind coxae; abdominal segments 1 thru 4 and part of 5 more or less reddish; scutellum fully as wide as long..... *evetrivorus* p. 79
- 1'. Neck of propodeum approximately half as long as length of hind coxae; abdominal segments 1 thru 4 more or less reddish; scutellum longer than wide..... *clavipes* p. 79

#### Superfamily Chalcidoidea

#### Family Eulophidae

#### Key to Subfamilies

1. Submarginal vein entire and usually shorter than marginal vein; postmarginal vein present; stigmal vein usually long and distinct (Fig. 3b)..... 2
- 1'. Submarginal vein broken or interrupted distally, length variable; postmarginal vein usually short or absent; stigmal vein usually short (Fig. 3d)..... 3
- 2(1). Parapsidal furrows distinct and complete..... Elachertinae (3 genera) p. 26
- 2'. Parapsidal furrows incomplete or absent..... Eulophinae (1 genus) p. 81

- 3(1'). Postmarginal vein absent; scutellum with two longitudinal grooved lines; submarginal vein usually longer than marginal vein (Fig. 3d)..... Tetrastichinae (1 genus) p. 26
- 3'. Postmarginal vein present; scutellum without grooved lines; submarginal vein very short (Fig. 3c); marginal vein very long ..... Entedontinae (1 genus) p. 27

#### Subfamily Tetrastichinae

##### Genus *Tetrastichus*

##### Key to Species (23)

1. Body elongate, slender; head rounded, with antennae inserted approximately in center of frons, well above level of ventral margins of compound eyes; postocellar line only slightly, if at all, longer than ocellocular line..... *longicorpus* p. 83
- 1'. Antennae inserted at or near level of ventral margins of compound eyes, and much below center of frons; postocellar line at least one and one-half times as long as ocellocular..... 2
- 2(1'). Mesopraescutum with bristles distributed over entire surface; or, at least, with more than two rows of bristles at each lateral margin..... 3
- 2'. Mesopraescutum with one or two rows of bristles at each lateral margin..... *marylandensis* p. 83
- 3(2). Marginal vein of forewing three or more times as long as stigmal vein..... *turionum* p. 82
- 3'. Marginal vein of forewing twice as long as stigmal vein (Fig. 3d)..... *coerulescens* p. 82

#### Subfamily Elachertinae

##### Key to Genera

1. Scutellum with longitudinal, lateral grooved lines..... 2
- 1'. Scutellum without longitudinal, lateral grooved lines..... *Paraolinx* (1 species) p. 84
- 2(1). Head in front view triangular and broader than high; axillae and scutellum do not form a straight line anteriorly..... *Elachertus* (2 species) p. 27
- 2'. Head not as above; axillae and scutellum form a straight line anteriorly..... *Hyssopus* (2 species) p. 27

Genus *Elachertus*

Key to Species (57)

1. Abdomen shining black with a pale yellowish basal spot.....  
..... *pini* p. 84
- 1'. Abdomen yellow to light yellow-brown.....  
..... *proteoteratis* p. 85

Genus *Hyssopus*

Key to Species

1. Pronotum longer than broad, marginal vein 3 times as long as stigmal..... *rhysacioniae* p. 85
- 1'. Pronotum a little broader than long, marginal vein about twice as long as stigmal.....  
..... *thymus* p. 86

Subfamily Entedontinae

Genus *Euderus*

Key to Species

1. Ocellocular line as long as diameter of lateral ocellus; color blue-green..... *subopacus* p. 87
- 1'. Ocellocular line less than diameter of lateral ocellus; color blue..... *argyresthia* p. 87

Family Eupelmidae

Key to Genera

1. Wingless; only females known.....  
..... *Eupelmella* (1 species) p. 89
- 1'. Winged species..... 2
- 2(1'). Scutellum with tuft of hairs; hind tibia flat with white border  
..... *Encyrtaspis* (1 species) p. 90
- 2'. Scutellum without tuft of hairs; hind tibia not flat.....  
..... *Eupelmus* (2 species) p. 28

Genus *Eupelmus*

Key to Species

According to B. D. Burks, USDA taxonomist, the distinction between these two species is not very great and there are intergrades between these characters.

1. Apical three-fourths of ovipositor sheaths are dark, basal white band about one-third as wide as the dark band.....  
..... *cyaniceps amicus* p. 88
- 1'. Apical one-half of ovipositor sheaths are dark, basal white band is about one-half as wide as the dark band.....  
..... *cyaniceps cyaniceps* p. 89

Family Perilampidae

Genus *Perilampus*

Key to Species (118)

1. Frons with a carina extending from behind anterior ocellus downward on each side of scrobal cavity to level of insertion of antennae, or nearly to that point.....  
..... *hyalinus* p. 91
- 1'. Frons without such carina or at most with an indistinct one that extends lateral from ocellus for a short distance only.....  
..... 2
- 2(1'). First tergite, exclusive of invaginated anterior portion, very short, transversely linear or at least several times as broad as long, usually smooth or weakly sculptured and generally with anterior margin more or less elevated into a flangelike projection that masks more or less posterior aspect of neck of propodeum..... *tristis* p. 91
- 2'. First tergite more distinctly petioliform, rarely more than three times as broad as long, as a rule more or less rugosely sculptured and without a marginal flange anteriorly.....  
..... *fulvicornis* p. 90



Family Torymidae

Genus *Monodontomerus*

Key to Species (59)

1. Tooth on posterior femur about its own length before apex of femur (Fig. 4k); punctate groove setting off marginal frenal of scutellum continued uninterruptedly around apex (Fig. 4f)..... *dentipes* p. 92
- 1'. Tooth on posterior femur at least twice its own length before apex of femur (Fig. 4j); punctate groove setting off marginal frenal of scutellum more or less interrupted at apex (Fig. 4g).. ..... *minor* p. 92

Family Pteromalidae

Key to Genera

1. Cheeks excavated..... *Catolaccus* (1 species) p. 93
- 1'. Cheeks not excavated..... 2
- 2(1'). Occipital carina..... *Dibrachys* (1 species) p. 93
2. Occipital carina absent..... *Habrocytus* (2 species) p. 29

Genus *Habrocytus*

Key to Species

According to B. D. Burks, USDA taxonomist, these two species are very close and may be the same.

1. Lateral furrows of propodeum wide, deep, and transversely corrugated..... *thyridopterigis* p. 94
- 1'. Lateral furrows of propodeum shallower, narrower, and not transversely corrugated..... *phycidis* p. 94

Family Chalcididae

Key to Subfamilies

1. Abdomen with elongate petiole..... Chalcidinae (1 genus) p. 30
- 1'. Abdomen sessile or nearly so..... Haltichellinae (1 genus) p. 30

Subfamily Haltichellinae

Genus *Haltichella*

Key to Species (57)

1. First abdominal tergite finely striated at extreme base and finely shagreened over most of the remaining surface except a broad smooth border along the posterior margin (Fig. 4n).....  
..... *rhyacioniae* p. 97
- 1'. First abdominal tergite striated at extreme base but otherwise perfectly smooth and polished (Fig. 4m).....  
..... *xanticles* p. 98

Subfamily Chalcidinae

Genus *Spilochalcis*

Key to Species (22)

1. Males: antennal scape extremely stout, with a prominent darkened anterior carina, apex exceeding level of vertex. Females: length of dorsal arch of the last abdominal segment greater than length of eighth tergite (ratios varying from 14:9 to 12:9) (Fig. 4p).....  
..... *flavopicta* p. 98
- 1'. Males: antennal scape slender, without a darkened anterior carina, apex not exceeding level of vertex. Females: length of dorsal arch of last abdominal segment equal to or less than length of eighth tergite (Fig. 4o).....  
..... *leptis* p. 99

Superfamily Bethyloidea

Family Bethylidae

Genus *Goniozus*

Key to Species (50,134)

1. Stigma and parastigma brown.....  
..... 2
- 1'. Stigma and parastigma black.....  
..... *foveolatus* p. 100
- 2(1). Branch of basal vein about as long as the upper abscissa of the basal vein (Fig. 3e).....  
..... *longinervis* p. 101
- 2'. Branch of basal vein very short, not as long as the upper abscissa of the basal vein (Fig. 3g).....  
..... 3

- 3(2'). Female: head about one and one-fifth times as long as wide; eyes a little longer than the head behind them. Male: head slightly more than one and one-sixth times as long as wide; eyes about one and one-third times as long as the head behind them.....  
..... *columbianus* p. 99
- 3'. Female: head about one and one-half times as long as wide; eyes a little shorter than the head behind them. Male: head a little longer than one and three-tenths times as long as wide; eyes about one and one-tenth as long as the head behind them.....  
..... 4
- 4(3'). Pronotum distinctly shorter than the mesonotum and scutellum combined..... *longiceps* p. 101
- 4'. Pronotum equal to or longer than the mesonotum and scutellum combined..... *electus* p. 100

#### Family Tachinidae

##### Key to Genera

1. Eyes hairy..... 2
- 1'. Eyes bare..... 4
- 2(1). Next to last segment of arista not over twice as long as wide..  
..... 3
- 2'. Next to last segment of arista at least three times as long as wide..... *Madremyia* (1 species) p. 106
- 3(2). Pteropleural bristle very long and strong, extending to abdomen; frontal bristles extending to the middle of the third antennal segment..... *Lypha* (1 species) p. 103
- 3'. Pteropleural bristle of normal length or weak; frontal bristles decreasing in length upwardly and not extending below the base of the arista..... *Nemorilla* (1 species) p. 106
- 4(1'). Next to last arisal segment over three times as long as wide..  
..... *Actia* (1 species) p. 105
- 4'. Next to last arisal segment not over twice as long as wide (Figs. 4h, 4i)..... 5
- 5(4'). First posterior cell (R<sup>5</sup>) strongly petiolate apically (Fig. 3h)..... *Erynnia* (1 species) p. 105
- 5'. First posterior cell (R<sup>5</sup>) not petiolate apically, reaches margin (Fig. 3f)..... 6

- 6(5'). Parafacials with a number (10) of fine hairs.....  
 ..... *Urophyllopsis* (1 species) p. 105
- 6'. Parafacials without fine hairs.....  
 ..... *Lixophaga* (2 species) p. 32

Genus *Lixophaga*

Key to Species

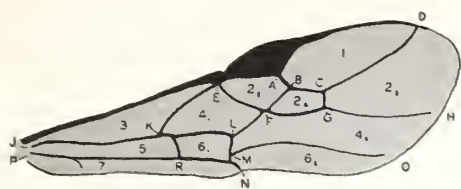
1. Arista at most slightly longer than the third antennal segment,  
 thin terminal part of arista distinctly shorter than thickened  
 basal portion (Fig. 4h); parafacial below broader than third  
 antennal joint viewed from side.....  
 ..... *plumbea* p. 104
- 1'. Arista much longer than the third antennal segment; thin  
 terminal part of arista equal to or longer than thickened basal  
 portion (Fig. 4i); parafacial below narrower than third antennal  
 joint viewed from side.....  
 ..... *mediocris* p. 104

## *Figures*

Figure 1.

a, Generalized Braconidae fore-wing. Veins: ABCD, radius; EFGH, cubitus; JK, medius; KLM, discoideus; MO, subdiscoideus; PR, submedius; RN, brachius; EK, basal: BF, first intercubitus; CG, second intercubitus; FL, recurrent; KR, nervulus. Cells: 1, radial; 2<sub>1</sub>, first cubital; 2<sub>2</sub>, second cubital; 2<sub>3</sub>, third cubital; 3, medial; 4<sub>1</sub>, first discoidal; 4<sub>2</sub>, second discoidal; 5, submedial; 6<sub>1</sub>, first brachial; 6<sub>2</sub>, second brachial; 7, anal. Fore-wings: b, *Bracon hebetor* Say; c, *Apanteles bushnelli* Muesebeck; d, *Ascogaster* sp.; e, *Agathis acrobasis* (Cushman); f, *Orgilus obscurator* (Nees); g, *Microgaster epagoge* Gahan; h, *Bracon variabilis* (Provancher); i, *Chelonus* sp.; j, *Bracon mellitor* Say.

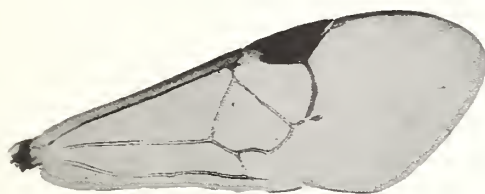




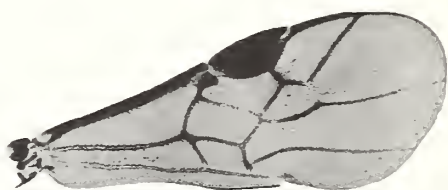
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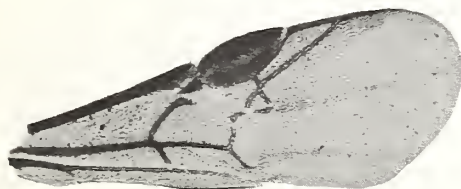
*b*



*c*



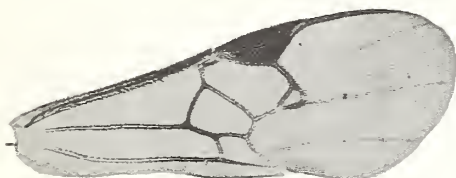
*d*



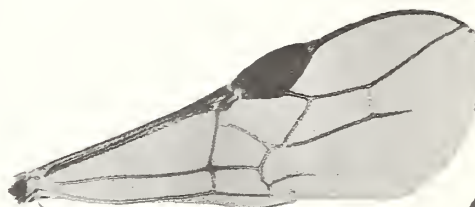
*e*



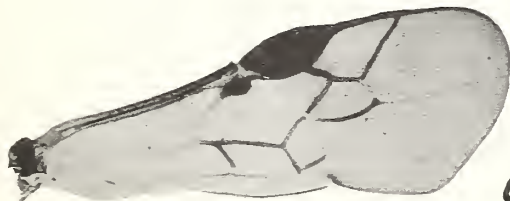
*f*



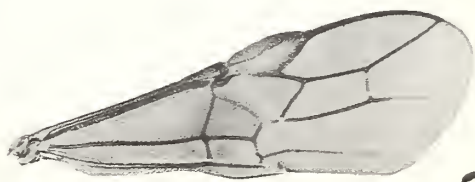
*g*



*h*



*i*

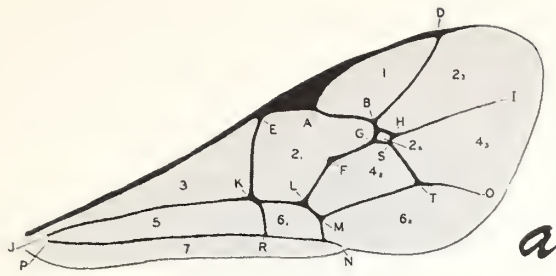


*j*

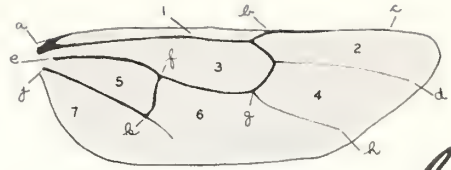
Figure 2.

a, Generalized Ichneumonidae fore-wing. Veins: ABD, radius; FI, cubitus; JK, medius; KLM, discoideus; MO, subdiscoideus; PR, submedius; RN, brachius; EK, basal; BG, first intercubitus; BH, second intercubitus; FL, first recurrent; ST, second recurrent; KR, nervulus. Cells: 1, radial; 2<sub>1</sub>, first cubital & first discoidal; 2<sub>2</sub>, second cubital or aerolet; 2<sub>3</sub>, third cubital; 3, medial; 4<sub>2</sub>, second discoidal; 4<sub>3</sub>, third discoidal; 5, submedial; 6<sub>1</sub>, first brachial; 6<sub>2</sub>, second brachial; 7, anal.

b, hind-wing. Veins: abc, subcostella; bd, radiella; gh, cubitella; efg, mediella; jk, submediella; bg, basella; fk, nervellus. Cells: 1, costellan; 2, radiellan; 3, mediellan; 4, cubitellan; 5, submediellan; 6, discoidellan; 7, anallan. Fore-wings: c, *Macrocentrus cuniculus* Walley; d, *Macrocentrus instabilis* Muesebeck; e, *Earinus zeirapherae* Walley. Hind-wings: f, *Scambus* sp.; g, *Iseropus* sp.



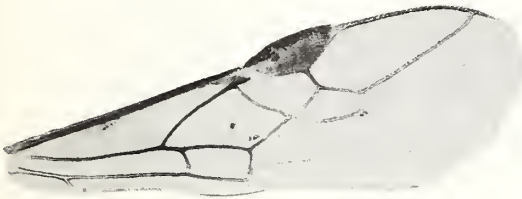
a



b



c



d



e



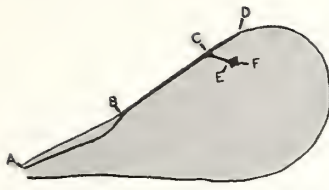
f



g

Figure 3.

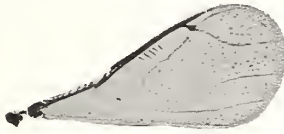
a, Generalized Chalcidoidea fore-wing. Veins: AB, submarginal; BC, marginal; CD, postmarginal; CE, stigmal; F, stigma. Fore-wings: b, *Elachertus proteoteratis* Howard; c, *Euderus argyresthiae* (Crawford); d, *Tetrastichus coerulescens* Ashmead; e, *Goniozus longinervis* Fouts; f, *Lixophaga mediocris* Aldrich; g, *Goniozus columbianus* Ashmead; h, *Erynnia tortricis* (Coquillett).



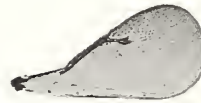
a



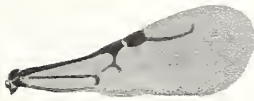
b



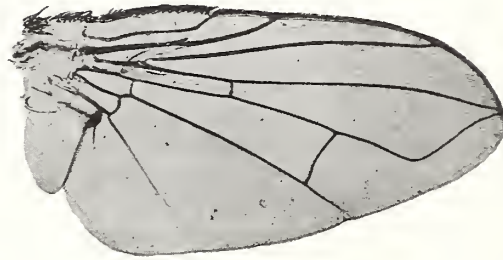
c



d



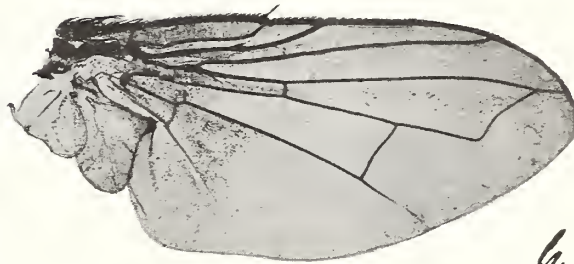
e



f



g



h

Figure 4.

Pronotum, dorsal view: a, Pteromalidae; b, Eurytomidae; c, Perilampidae; d, Macrocentrinae, clypeus not emarginate below; e, Braconinae, clypeus semicircularly emarginate below; f, *Monodontomerus dentipes* (Dalman), dorsal view of thorax; g, *Monodontomerus minor* (Ratzeburg), dorsal view of scutellum; h, *Lixophaga plumbea* Aldrich, antenna; i, *Lixophaga mediocris* Aldrich, antenna; j, *Monodontomerus minor* (Ratzeburg), femur lateral view; k, *Monodontomerus dentipes* (Dalman), femur lateral view; l, *Agathis acrobasidis* (Cushman), abdomen dorsal view; m, *Haltichella xanticles* (Walker), abdomen dorsal view; n, *Haltichella rhyacioniae* Gahan, abdomen dorsal view; o, *Spilochalcis leptis* Burks, female, lateral view of abdomen; p, *Spilochalcis flavopicta* (Cresson), female, lateral view of abdomen.



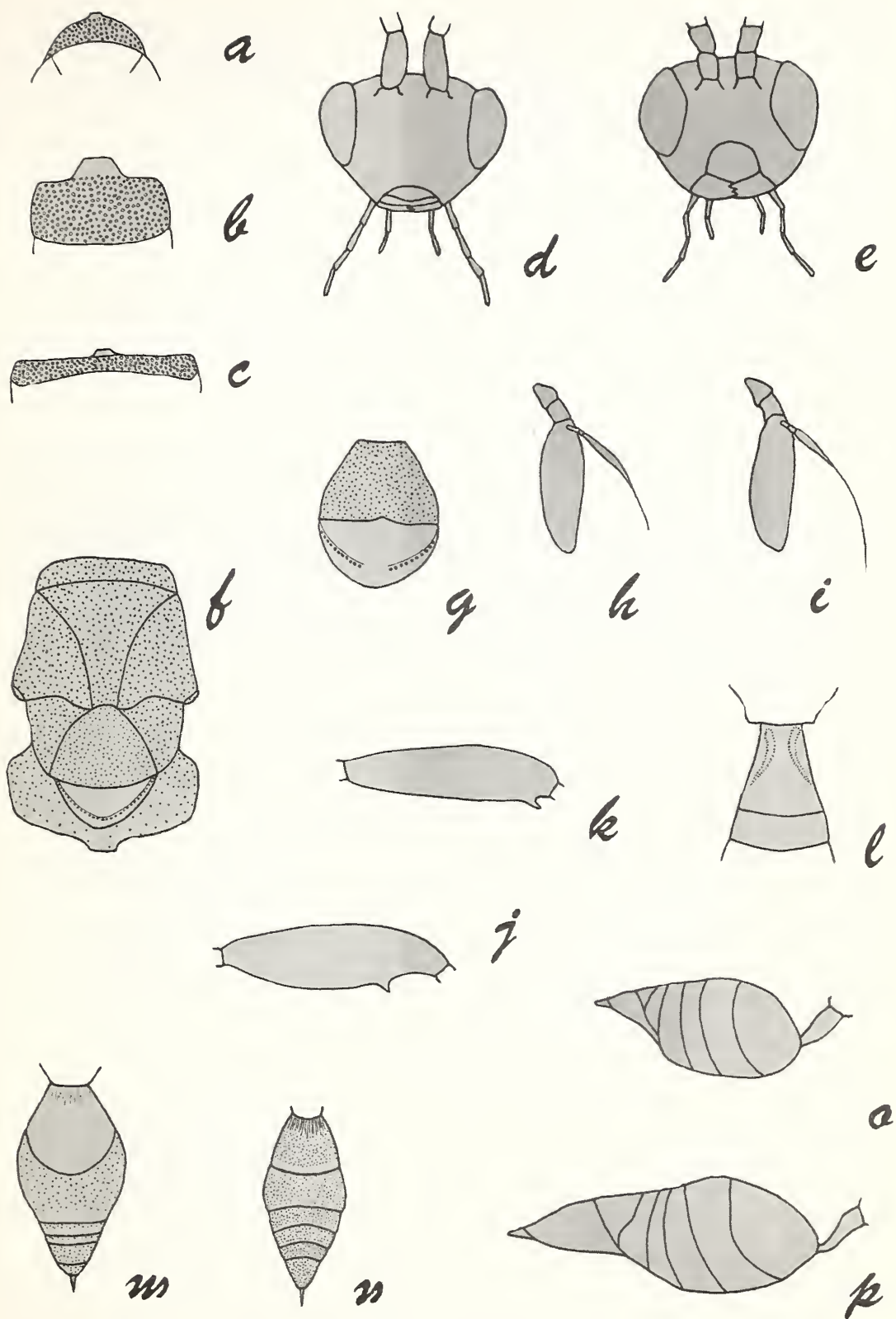


Figure 5.

First abdominal segment, lateral view; a, *Campoplex* sp.; b, *Diadegma* sp.; c, Ichneumoninae; d, *Pimpla* sp., eyes weakly emarginate; e, *Itoplectis* sp., eyes strongly emarginate; f, abdomen dorsal view, *Dolichomitus* sp.; g, abdomen dorsal view, Glyptini; h, lateral view of thorax, Pimplini; i, lateral view of thorax, Ephialtini; j, lateral view of propodeum, *Temelucha rhyacioniae* (Cushman); k, lateral view of propodeum, *Temelucha evetriae* (Cushman).

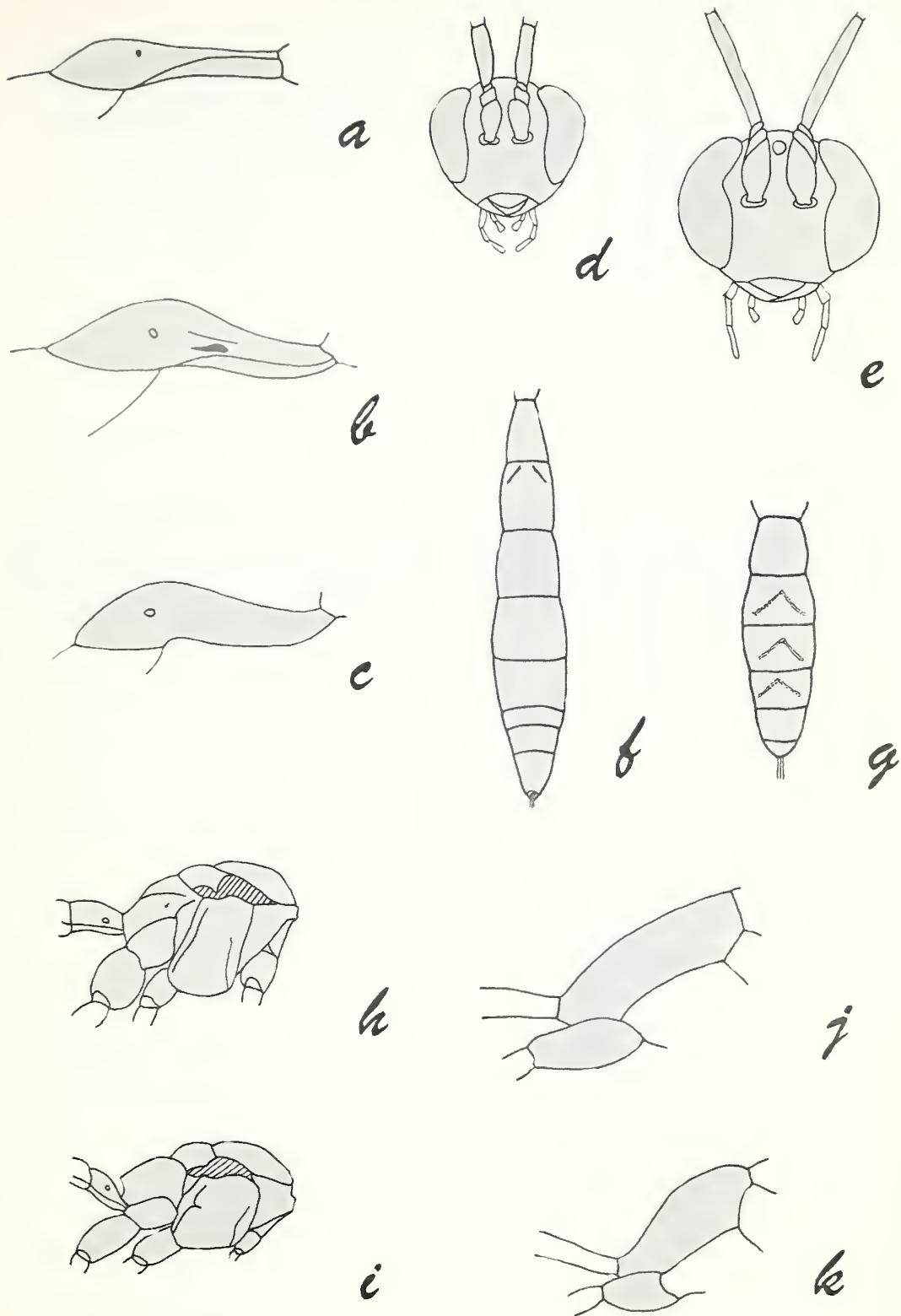


Figure 6.

a, *Chelonus* (*Chelonus*) *annulipes* Wesmael (16,131); b, *Apanteles epinotiae* Viereck (105); c, *Bracon variabilis* (Provancher) (105); d, *Agathis acrobasis* (Cushman) (105); e, *Macrocentrus ancyliivorus* Rohwer (61); f, *Meteorus hyphantriae* Riley (71).

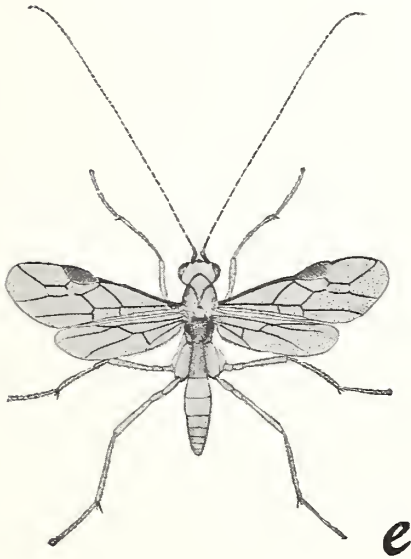
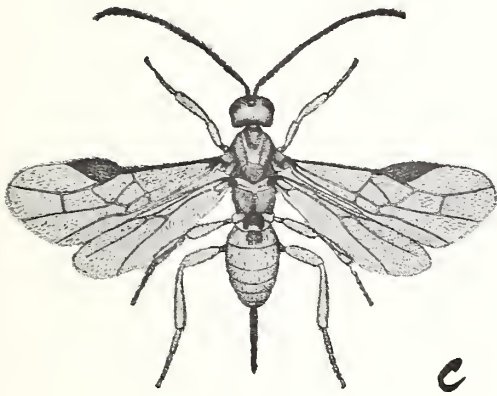


Figure 7.

a, *Itoplectis conquisitor* (Say) (71); b, *Perilampus fulvicornis* Ashmead (105); c, *Vibrachys cavus* (Walker) (71); d, *Habrocytus thyridopterigis* Howard (71); e, *Goniozus* sp. (72); f, *Lixophaga mediocris* Aldrich.





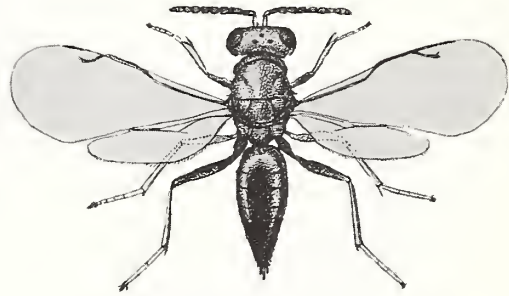
a



b



c



d



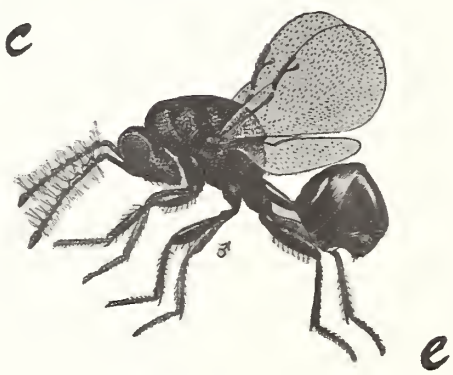
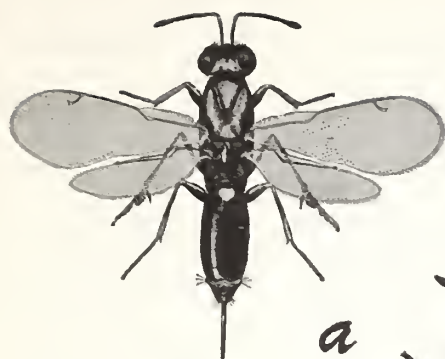
e



f

Figure 8.

a, *Eupelmus cyaniceps cyaniceps* Ashmead (73); b, *Tetrastichus hunteri* Crawford (73); c, *Eupelmella vesicularis* (Retzius) (58); d, *Eurytoma tylodermatis* Ashmead, female (73); e, *Eurytoma tylodermatis* Ashmead, male (73); f, *Trichogramma minutum* Riley (29); g, *Monodontomerus aereus* Walker (100).



## ANNOTATED SPECIES LIST

### ORDER HYMENOPTERA

#### Superfamily Ichneumonoidea

#### Family Braconidae

Two species are seriously questioned as parasitic of *Rhyacionia*. *Pauesia gellettei* (Gahan) and *Pauesia* sp. are reported as parasites of *R. frustrana* in South Carolina (48) but all members of this genus are aphid parasites.

*Heterospilus* sp. was collected by Cushman from *R. frustrana* material in Massachusetts but he states this genus is probably not parasitic on tip moth but more likely associated with a coleopterous borer (41). No member of this genus has been found associated with *Rhyacionia* in the U. S. National Museum collection.

One citation of *Microbracon stabilis* Wan. parasitic of *R. buoliana* is found for Southern Ontario (116). This is probably an error and was meant to be *Bracon stabilis* Wesmél. This latter species has been introduced but has not been shown to be established.

*Meteorus* sp. prob. *hyphantriae* Riley

#### Literature Record:

- Size : Body length, ♀ 5 mm, wing span 11 mm (111)
- Range : All of U. S. and Canada (104); W. Va. (67)
- Hosts : *R. buoliana* (67)
- Annotations : Most species of *Meteorus* are parasites of lepidopterous larvae but some parasitize Coleoptera (104). Pictured in Figure 6f.

*Macrocentrus ancyllivorus* Rohwer

Literature Record: *Macrocentrus ancyllivora*! Rohwer (113)

- Size : Body length, ♂ 3.5 mm; ♀ 4.5 mm, ovipositor 5.5 mm (113)
- Range : U. S. (104); N. S. to Man. (79); S. C. (48)
- Hosts : *R. frustrana* (48)
- Annotations : Pictured in Figure 6e.

*Macrocentrus cuniculus* Walley

Literature Record:

- Size : Body length, ♀ 5 mm, ovipositor sheaths 8.5 mm (136)
- Range : Ont., N. B., Idaho, Mont., Calif. (104); Man., Sask. (79); N. B. (136)
- Hosts : *Evetria* sp. (136)
- Annotations : Reared from possibly new species of pitch moth at Fredericton, N. B. (136).

*Macrocentrus instabilis* Muesebeck

Literature Record: *Macrocentrus laspeyresiae* Muesebeck (101)

- Size : Body length, ♂ 5 mm; ♀ 5 mm (101)
- Range : N. Y. and Ohio to Fla., and Texas, Wash. (104); S. C. (48); Fla. (101)
- Hosts : *R. rigidana* (101,104)  
*R. frustrana* (48)
- Annotations :

*Macrocentrus* sp.

Literature Record:

- Size :
- Range : European; introduced Conn., N. J. (46)
- Hosts : *R. buoliana* (46)
- Annotations : This *unknown* parasite species was introduced from Europe in 1937! (46).

*Orgilus obscurator* (Nees)

Literature Record: *Orgilus obscurator* Nees (54)

Size : Body length 3.9 mm

Range : Canada (75,83,104,122); Conn. (1,54,68,104); Mich. (95); Ont. (4,5,8,31,46,76,90,108,109,115,116,139); Que. (18,90,109); R. I., Conn., N. Y. (46,47); W. Va. (67); Mass., R. I., Conn. (114); N. J. (46); Md. (81); R. I. (47)

Hosts : *R. buoliana* (1,4,5,8,18,26,28,31,46,47,54,67,68,75,76,81,83,90,95,104,108,109,114,115,116,122,139)

Annotations : Very important introduced internal larval parasite (8, 46,54,75,81,83). Undoubtedly introduced accidentally since it was found prior to any intentional release (46,139); established but control value, if any, doubtful (90). Attacks very young shoot moth larvae and hibernates in host (46,67,95,114). Only known host in North America is the shoot moth but it has several hosts in Europe; one generation per year; when development is complete, it emerges from host larva or pupa and spins a thin white cocoon in the host mine (46). Oviposits in the early instar larvae during July and August and parasite overwinters as an early instar larva within hibernating host; adults emerge in mid-June and mid-August (139). Three cases of two individuals emerging from a single host have been reported (139). Complete life history and morphology of the immature stages are given (5,75).

One of the four most common parasites in Ontario (5). Infestation reported as 14% (68) and 20% (1) in Connecticut, 75% (109) and 85% (18) in Quebec, and 87% in Ontario (139) of total parasitism, was found to equally parasitize host on both Scotch pine, *Pinus sylvestris* L., and red pine, *P. resinosa* Ait. (4). In Ontario parasite is as resistant to low temperatures as its host and percentage infestation was found equal at all of three tree levels (76). Of the hosts parasitized by *Orgilus obscurator*, 80% were parasitized by *Temelucha interruptor* suggesting that the latter species "prefer" previously parasitized hosts (8). Longevity of parasites confined with flowering wild carrot, *Daucus carota* L., was  $20.0 \pm 5.3$  days while longevity of parasite confined with non-flowering plants was  $4.2 \pm 2.1$  days. Speculated that wild carrot contributes to the success of this parasite in Canada (122); attractiveness of different foods and flowers studied (83).



*Orgilus* sp.

Literature Record:

Size :  
Range : S. C. (48)  
Hosts : *R. frustrana* (48)  
Annotations :

*Earinus zeirapherae* Walley

Literature Record:

Size : Body length; ♂ 4 mm, ♀ 4 mm (137)  
Range : N. S. (Grand River) (104); N. S. to B. C., and Alaska (79); Ont. (87)  
Hosts : *R. adana* (87)  
Annotations : Solitary larval parasite (87).

*Agathis acrobasis* (Cushman)

Literature Record: *Bassus acrobasis* Cushman (39)

Size : Body length, ♂ 6 mm; ♀ 6 mm, ovipositor 4 mm (39)  
Range : N. C., Ga., Fla., Miss., Ark., Texas, Colo. (104); Ohio (97); S. C. (48)  
Hosts : *R. frustrana* (48)  
*R. rigidana* (97)  
Annotations : Reared from one host generation only (97). Pictured in Figure 6d.

*Agathis annulipes* (Cresson)

Literature Record:

- Size : Body length, 4.1-4.6 mm (35)
- Range : Ont. to Fla., west to S. D. and Kans. (104); Ohio (97)
- Hosts : *R. rigidana* (97)
- Annotations : Reared from both host generations (97).

*Agathis binominata* Muesebeck

- Literature Record: *Bassus bicolor* (Prov.) (130)  
*Agathis bicolor* (Provancher) (79,104)  
*Agathis binominata* is a new name since *bicolor* was preoccupied (79)

- Size : Body length, ♂ 2.8 mm; ♀ 4.3 mm
- Range : N. B. to Va., Ont. (104); Va. (130)
- Hosts : *R. frustrana* (130)
- Annotations :

*Agathis pini* (Muesebeck)

- Literature Record: *Bassus pini* Muesebeck (103)

- Size : Body length, ♀ usually 5-7 mm (103)
- Range : Maine to Va., Ohio (104); Maine, Ohio, Mass., N. Y., Pa., Va. (103); Mass. (114); Ohio (93)
- Hosts : *R. frustrana* (103,104,114)  
*Evetria* sp. (103,104)
- Annotations : Probably two generations a year with only one parasite per host (114). Internal larval parasite (93). In an Ohio study 40% of this parasite were parasitized by the hyperparasite *Perilampus fulvicornis* Ashmead (93).

*Agathis* n. sp.

Literature Record:

Size :  
Range : Mass., Maine (114)  
Hosts : *R. buoliana* (114)  
Annotations : Only one parasite per host with at least two generations per year (114).

*Agathis* sp.

Literature Record:

Size :  
Range : S. C. (48)  
Hosts : *R. frustrana* (48)  
Annotations :

*Apanteles bushnelli* Muesebeck

Literature Record:

Size : Body length ♀ 3 mm (102)  
Range : Neb., Calif. (104); Iowa (79); Neb. (102)  
Hosts : *R. pasadenana* (104)  
          *R. frustrana* var. *bushnelli* (102,104)  
Annotations :

*Apanteles epinotiae* Viereck

Literature Record:

- Size : Body length, ♂ 2 mm (133)
- Range : Maine to Fla., west to Ill., Neb. and Texas (104);  
W. Va. (67); N. J. (133)
- Hosts : *R. buoliana* (67)
- Annotations : Only one record from *Rhyacionia* (67). Pictured in  
Figure 6b.

*Apanteles petrovae* Walley

Literature Record:

- Size : Body length, ♀ 3.4 mm (138)
- Range : Ont. (Constance Bay) (104); Newfoundland, N. B. (79);  
S. C. (48)
- Hosts : *R. frustrana* (48)
- Annotations :

*Apanteles* sp.

Literature Record:

- Size :
- Range : La. (41); S. C. (48); Wisc. (124)
- Hosts : *R. frustrana* (41,48)  
*R. buoliana* (124)
- Annotations : Internal larval parasite (41). Single questionable  
specimen collected (124).

*Microgaster epagoges* Gahan

Literature Record:

- Size : Body length, ♂ 3.5 mm; ♀ 3.5 mm (56)
- Range : Mass. to S. C., west to Iowa and Colo.; B. C. (104);  
Ont. (79); Mass. (114)
- Hosts : *R. frustrana* (104,114)
- Annotations : One parasite per host with at least 2 generations per  
year. Adults emerge June and July (114). All species  
seem to be internal parasites of Lepidoptera larvae  
(104).

*Phanerotoma rhyacioniae* Cushman

Literature Record:

- Size : Body length, ♀ 2.7 mm (42)
- Range : Va., La., Miss. (104); Va. (130); La. (41,42)
- Hosts : *R. frustrana* (41,42,104,130)
- Annotations : Very important internal larval parasite in Louisiana  
probably depositing its eggs in tip moth egg; probably  
solitary (41). Members of this genus are parasites of  
lepidopterous larvae. Eggs are laid in eggs of the  
host but the parasitic larvae do not become mature  
until the hosts have reached maturity (104).

*Ascogaster* sp.

Literature Record:

- Size :
- Range : Ont. (110)
- Hosts : *R. buoliana* (110)
- Annotations : Parasites of lepidopterous larva. Eggs are laid in  
eggs of the host but the parasitic larvae do not  
become mature until the hosts have reached maturity  
(104). Adults emerged 25 June (110).

*Chelonus* sp.

Literature Record:

- Size :  
Range : Conn. (55)  
Hosts : *R. buoliana* (55)  
Annotations : Larval parasite (55). Eggs of this genus are laid in the host egg but the parasitic larvae do not become mature until hosts have reached maturity (104). *Chelonus* (*Chelonus*) *annulipes* Wesmael pictured in Figure 6a. Detailed biological studies given for this species (16,131).

*Bracon gelechia* Ashmead

Literature Record: *Microbracon gelechia* (Ashmead) (41,130)

- Size : Body length, ♂ 2.2 mm; ♀ 2.2 mm, ovipositor 0.6 mm (12)  
Range : All U. S. (104); N. S. to B. C.; Bermuda; Mexico; India (79); eastern U. S. and West Coast (41); Va. (41,130); Neb. (66); Ohio (96); S. C. (48); Mass., N. Y. (114); Ont. (139); Wisc. (124)  
Hosts : *R. frustrana* (41,48,130)  
*R. buoliana* (79,96,114,124,139)  
*R. frustrana* var. *bushnelli* (66,104)  
Annotations : Gregarious, external (41,124) larval parasite with as many as six per host (114). Two or more generations per year; adults emerge in June and August (114). Single specimen emerged in Ontario 9 June (139). Attacks large larvae and spins dense brown cocoon (41). Larva described and illustrated (124).



*Bracon gemmaecola* (Cushman)

Literature Record: *Microbracon gemmaecola* Cushman (17,41,42,55,130)

- Size : Body length, ♀ 2.5 mm (42)
- Range : Mass., Conn., Va., Neb., Ariz. (104); Va., Mass. (41); Va. (130); N. C. (17); Mass. (42); S. C. (48); Ohio (97); Mass., N. J. (114); Conn (55)
- Hosts : *R. frustrana* (17,41,42,48,104,114,130)  
*R. frustrana* var. *bushnelli* (104)  
*R. neomexicana* (104)  
*R. buoliana* (104)  
*R. rigidana* (97)
- Annotations : External larval parasite (41). At least two generations per year with the adults emerging late in May and June (114).

*Bracon mellitor* Say

Literature Record: *Microbracon mellitor* (Say) (41,66,130)

- Size : Body length, ♂ 2 mm; ♀ 3 mm, ovipositor 2 mm (12)
- Range : U. S., Hawaii, Mexico (104); eastern U. S., Va. (41); southern Ont. (87); Va. (130); Neb. (66); S. C. (48)
- Hosts : *R. adana* (87)  
*R. frustrana* (41,48,130)  
*R. frustrana* var. *bushnelli* (66)
- Annotations : Parasitic of both coleopterous and lepidopterous larvae; external, solitary and pupates in a white to brownish, opaque cocoon (41). Gregarious larval parasite (87).

*Bracon hebetor* Say

Literature Record:

- Size : Body length, ♀ 2.5 mm, sheath of ovipositor 0.5 mm (132)
- Range : All of U. S., cosmopolitan (104); Ohio (97)
- Hosts : *R. rigidana* (97)
- Annotations : One generation per year (97).

*Bracon politiventris* (Cushman)

Literature Record: *Habrobracon politiventris* Cushman (37)  
*Bracon poliventris*! (Cushman) (79)

- Size : Body length, ♀ 2.25 mm (37)
- Range : Ont. to Va., west to Oreg. and Colo., La. (104);  
N. S. to B. C. (79); Ohio (96); Mass. (114)
- Hosts : *R. buoliana* (96,104,114)
- Annotations : One parasite per host with two (?) generations per year. Adults emerge in June (114).

*Bracon rhyacioniae* (Muesebeck)

Literature Record: *Microbracon rhyacioniae* Muesebeck (99)

- Size : Body length, ♀ 3.8 mm (99)
- Range : S. D., Neb., Idaho, Calif. (104); Que. to Sask. (79);  
S. D. (99)
- Hosts : *R. sp.* (99,104)  
*R. frustrana* (104)  
*R. frustrana* var. *bushnelli* (104)  
*R. neomexicana* (104)
- Annotations :

*Bracon variabilis* (Provancher)

Literature Record: *Microbracon variabilis* (Provancher) (106)

Size : Body length, ♀ 2.8 mm; ovipositor 0.8 mm (12)

Range : Que. to Va., west to Mo. and Texas (104)

Host : *R. frustrana* var. *busnelli*! (106)

Annotations : Pictured in Figure 6c.

*Bracon* n. sp.

Literature Record:

Size :

Range : Wisc. (124)

Hosts : *R. buoliana* (124)

Annotations : External larval parasite with 1-3 per host; emerged in Wisconsin from 1 July to 16 July; three found in conjunction with six *Habrocytus thyridopterigis*; larva described and illustrated (124).

*Bracon* sp.

Literature Record: *Microbracon* (121)

Size :

Range : Neb. (121); S. C. (48)

Hosts : *R. frustrana* (48)  
*R. frustrana* var. *bushnelli* (121)

Annotations :

## Family Ichneumonidae

Specimens from four genera of the subfamily Cryptinae have been recorded as *Rhyacionia buoliana* parasites. These include *Alegina* sp. (139), *Idemum* sp. (139), and *Hemiteles* sp. (116) all from Ontario and *Gambrus* sp. from Wisconsin (123,124). All these citations are based on rearings of only one or two individuals and are considered questionable. I have therefore made provisions in the key to separate these specimens only to subfamily.

Erroneous *R. buoliana* citations include *Pimpla detrita* Hlgr. (= *Scambus* [Endromopoda] *detritus* [Holmgren]) from Ontario (116). *Hypsicera* nr. *femoralis* (Fourcroy) and *Syrphoctonus agilis* (Cresson) (= *Syrphoctonus flavolineatus* [Gravenhorst]) are recorded from Ohio (96). The former is believed to attack stored products Lepidoptera and it is doubtful if it attacks *Rhyacionia*, while *S. flavolineatus* is a parasite of Syrphidae. Specimens of the Palearctic *Lissonota culiciformis* Gr. (116) reported by Sheppard were never located and it is strongly suspected this species was never successfully introduced. *Pristomerus orbitalis* Holmgren is also listed by Sheppard as attacking *R. buoliana* in Ontario (116). Attempts have been made to introduce this European parasite into Canada but, as far as is known, it has never become established and is therefore omitted from the keys and annotated species lists.

*R. buoliana* parasite misidentifications from Ontario include *Ephialtes extensor* L. (116). Specimens have subsequently been correctly identified as *Exeristes comstockii* (Cresson).

Specimens labelled *Pimpla inquisitor* Scop. (116) in the Canadian National Collection indicate the males are *Exeristes comstockii* (Cresson) (Canadian origin) and the females are *Scambus* sp. (European origin). *Pimpla aequalis* Provancher (114,139) citations are all believed to be misidentifications of *Pimpla annulipes* Brullé.

### *Scambus* (*Ateleophadnus*) *pterophori* (Ashmead)

Literature Record: *Scambus pterophori* (Ashmead) (18)

Size : Front wing length, ♂ 3.0 to 6.5 mm; ♀ 5.0 to 8.5 mm (129)

Range : Que. (18); transcontinental range in the Canadian and Transition Zones (129).

Hosts : *R. buoliana* (18)

Annotations :

*Scambus (Scambus) aplopappi* (Ashmead)

- Literature Record: *Epiurus aplopappi* Ashmead (66,82)  
*Scambus aplopappi* (Ashmead) (104,127,140)  
*Scambus evetivorus* Rohwer (127)
- Size : Front wing length, ♂ 3.2 to 4.8 mm; ♀ 5.0 to 8.0 mm  
(129)
- Range : N. M., Ariz., Calif., Wash., Neb. (104); Calif. (82);  
Neb. (66); N. M., Ariz., Calif., Colo., Idaho (129)
- Hosts : *R. frustrana* var. *bushnelli* (66,104,127,129)  
*R. pasadenana* (82,104,127)
- Annotations : Solitary larval parasite (82).

*Scambus (Scambus) buoliana* (Hartig)

- Literature Record: *Scambus buoliana* (Hartig) (83,84,85,86)
- Size : Body length 7 mm
- Range : Ont. (83,84,85,86)
- Hosts : *R. buoliana* (83,84,85,86)
- Annotations : Introduced external larval parasite (83,85); greater  
fecundity when alternate hosts are available (85);  
females live longer and have greater fecundity when  
they are supplied with both carbohydrates and host  
larvae (84). Very close to *Scambus (Scambus) tecumseh*  
Viereck (84).

*Scambus (Scambus) hispae* (Harris)

- Literature Record: *Scambus hispae* (Harris) (3,5,18,31,79,96,97,104,114,127,139,140)  
*Epiurus indagator* Cresson (55)  
*Epiurus indagator* (Cresson) (41,130)
- Size : Front wing length, ♂ 3.5 to 5.5 mm; ♀ 4.0 to 7.5 mm (129)
- Range : Ohio (96,97); Que. (18); Ont. (3,5,31,139); Maine, R. I., Conn., N. Y., Mass. (114); transcontinental in Canada (104,129); Conn. (55); Va. (130); eastern U. S., and southern Canada (41)
- Hosts : *R. frustrana* (41,104,122,130)  
*R. rigidana* (97)  
*R. buoliana* (3,5,18,31,55,96,104,114,127,129,139)
- Annotations : External larval parasite (3,5,41,55); solitary (41,114); attacks large or full grown larvae (41); paralyzes the host before depositing eggs (3); adults emerge late June, July, Aug., and Sept., at least two generations per year, hibernates in host cocoon (114); life history, habits and immature stages described (5). Referred to as a complex including *Scambus (S.) hispae* and *Scambus (S.) tecumseh*; males easily separated but females less easily separated (139).

*Scambus (Scambus) tecumseh* Viereck

- Literature Record: *Scambus tecumseh* Viereck (3,5)
- Size : Front wing length, ♂ 2.0 to 5.5 mm; ♀ 4.5 to 8.5 mm (129)
- Range : W. Va. (67); Md. (81); Ont. (3,5); transcontinental especially abundant in the Transition and Canadian Zones (129); Wisc. (124)
- Hosts : *R. buoliana* (3,5,81,67,124,129)
- Annotations : External larval parasite that paralyzes the host before depositing eggs (3,5,); life history, habits and the immature stages are described (5). Sometimes a victim of the cleptoparasitic habit of *Eurytoma pini* (124).



*Scambus (Scambus) tenebrosus* Walley

Literature Record: *Scambus tenebrosus* (89)

Size : Front wing length, ♂ 3.0 to 3.25 mm; ♀ 3.5 to 4.0 mm  
(129)

Range : Man. (89); Colo., Ariz., Wash. (129)

Hosts : *R. frustrana* (89)

Annotations :

*Scambus* sp.

Literature Record:

Size :

Range : Mass. (114); Ont. (139); Que. (18); Wisc. (123,124)

Hosts : *R. frustrana* (114)  
*R. buoliana* (18,123,124,139)

Annotations : Adults emerge in Massachusetts in June and July; one per host; number of generations per year unknown (114); solitary, external, larval parasites (124).

*Exeristes comstockii* (Cresson)

- Literature Record: *Calliephialtes comstockii* (Cresson) (18,31,41,79,88,92,94,96,97,104,110,114,127,130,139,140)  
*Calliephialtes comstocki* Cresson (49,51,52,53,55)  
*Pimpla inquisitor* Scop. (misidentification) (116)  
*Ephialtes extensor* L. (misidentification) (116)
- Size : Front wing length, ♂ 5.5 to 6.8 mm; ♀ 6.0 to 11.5 mm (129)
- Range : W. Va., Md. (67,81); S. C. (48); Man. (89); Ont. (3,4,31,51,108,110,139); Que. (18); Mass. (46); Atlantic to Pacific (5); Va. (130); Conn. (52,53,55); Ohio (51,92,96,97); B. C. (88); Mass., Conn., N. Y. (114); Mich. (94); Fla. (79); Wisc. (123,124); transcontinental in Transition Zone (104)
- Hosts : *R. frustrana* (41,46,48,49,67,89,104,114,127,129,130)  
*R. buoliana* (3,4,5,18,31,49,51,52,53,55,67,81,88,92,94,96,104,108,110,114,123,124,127,129,139)  
*R. rigidana* (67,92,97,114,129)  
*R. sp.* (129)
- Annotatons : External larval parasite (3,4,5,124); solitary (41,52,92,94,124,139); parasitizes host before depositing eggs (3); attacks early instar larvae (67); peak emergence July 2-29 (123); life history and habits under laboratory conditions and immature stages described (5). Liberated against *bushnelli* variety in Nebraska, not known to be established (46). Occurred in approximately equal numbers on the two tree species, *Pinus resinosa* Ait. and *P. sylvestris* L. (4); parasitism more or less uniform throughout the tree at one-foot levels from 0-6 feet (108); shows preference for host at top of tree; very common in Maryland attacking *R. buoliana* (81). Two generations per year, summer generation develops and overwinters on an unknown host, egg to adult in 22 to 26 days, larva described and illustrated (124).

*Dolichomitus pterelas* (Say)

- Literature Record: *Pimpla pterelas* (Say) (104)  
*Ephialtes pterelas* (Say) (79,114)
- Size : Front wing length, ♂ 6.7 to 10 mm; ♀ 9.5 to 16 mm  
(129)
- Range : Transcontinental in Transition Zone (104); R. I. (114)
- Hosts : *R. buoliana* (114)
- Annotations : Adults emerge during June; one per host; probably two generations per year (114). Miss Walkley, USDA taxonomist, doubts that *Rhyacionia* is a true host.

*Dolichomitus terebrans nubilipennis* (Viereck)

- Literature Record: *Calliephialtes nubilipennis* (Viereck) (139)
- Size : Front wing length, ♂ 5 to 7.2 mm; ♀ 5.3 to 11.7 mm  
(129)
- Range : Ont. (139)
- Hosts : *R. buoliana* (139)
- Annotations : Indigenous (139); usual host is *Pissodes* (129)

*Pimpla annulipes* Brullé

Literature Record: *Pimpla aequalis* Provancher (misidentification) (114,139)

Size : Front wing length 4 to 8 mm (129)

Range : N. S. to Fla., west to Ont. and Texas, Wisc. (123,124);  
Ont. (139); Conn., N. Y., N. J. (114)

Hosts : *R. buoliana* (114,123,124,139)

Annotations : This species and *Pimpla aequalis* Provancher are very close and were once thought to be the same species but now are considered distinct. Records of *P. aequalis* Provancher attacking *R. buoliana* are therefore considered misidentifications.

Adults emerge in June and July; one parasite per host; two generations per year; hibernates in host pupae (114). Solitary internal parasite emerging from the pupa around 8 August in Wisconsin; larva described and illustrated (124).

*Pimpla hesperus* (Townes)

Literature Record: *Coccygomimus hesperus* Townes (129)

Size : Front wing length, ♂ 3.7 to 4.7 mm; ♀ 3.5 to 6.0 mm (129)

Range : Alaska, Ariz., Calif., Colo., N. M., Oreg., S. D.,  
Utah, Neb., Nev. (129)

Hosts : *R. frustrana* var. *bushnelli* (129)

Annotations :

*Pimpla sanguinipes* Cresson

Literature Record: *Coccygomimus sanguinipes* (Cresson) (129)

Size : Front wing length, ♂ 5.4 to 9.0 mm; ♀ 6.3 to 10.5 mm (129)

Range : Pacific to Continental Divide in Canada, Transition, and Upper Austral Zones (104); semidesert areas of the West and Southwest (129).

Hosts : *R. frustrana* var. *bushnelli* (104)

Annotations :

*Pimpla turionellae* (Linnaeus)

Literature Record: *Ephialtes turionellae* (L.) (19)  
*Ephialtes examiner* F. (7)  
*Coccygomimus turionellae* (L.) (129)  
*Pimpla examiner* Ratz.! (65)  
*Pimpla examiner* F. (9, 19)  
*Ephialtes* (*Ephialtes*) *turionellae* Linnaeus (40)

Size : Body length, ♂ 6.2 mm; ♀ 10.2 mm

Range : Canada (79); Ont. (7,9,46,65,86,109,139)

Hosts : *R. buoliana* (7,9,19,20,31,46,65,79,86,109,139)

Annotations : Introduced European pupal parasite (7,46,65,109,139); not recovered from the United States (46). Not well adapted to the region, several generations per year in the lab, lays internal egg in host pupa and larva feeds internally, pupation takes place inside pupal case, overwinters as adult and possibly at times in an immature stage (46). Takes 4.1 pupae for parasite to produce 1 adult, storage conditions mentioned (65). Influence of host pupal size on sex ratio, development time and size of the adults are discussed (9). May be reared on other hosts in the laboratory, habit of adult parasite feeding on host body fluids accounts for mortality of a greater number of host pupae, 90% of overwintering adults survived -11° F., literature summarized (7). May have been confused with *Pimpla aequalis* Provancher (40). Biology and habits outlined (19); embryology worked out in detail (20).

*Itoplectis conquisitor* (Say)

- Literature Record: *Ephialtes conquisitor* (Say) (88)  
*Ephialtes (Itoplectis) conquisitor* (Say) (40)
- Size : Front wing length 3.5 to 12.5 mm (129)
- Range : Atlantic to Rocky Mtns. in Transition (104); Ont. (3, 4, 5, 108, 110, 139); S. C. (48); Mich. (94); New England to Del. and Pa. (114); Va. (130); Neb. (66, 121); eastern U. S., south Canada and West Indies (41); Que. (18); Ohio (96); W. Va. (67); Md. (81); B. C. (88); Wisc. (124)
- Hosts : *R. frustrana* (41, 48, 104, 114, 127, 129, 130)  
*R. frustrana* var. *bushnelli* (66, 104, 121, 127, 129)  
*R. buoliana* (3, 4, 5, 18, 31, 67, 81, 83, 94, 96, 104, 108, 110, 114, 124, 127, 129, 139)  
*Evetria frustrana* (40, 126)
- Annotations : Internal pupal parasite (3, 5, 81, 83, 94, 124, 139); solitary (94, 139); adults emerged May, June, July, Aug., Sept., and Oct., one parasite per host, two or more generations per year; hibernates in host pupa (114). Adult parasites attack shoot moth pupae during late May and June, adults emerged from mid-June to mid-July (139); overwinters in some host other than the shoot moth and attacks shoot moth pupae in late May and early June (67); continued to attack as long as pupae were present (108); rare as a parasite of *R. frustrana* (too small) (41). Life history and habits in laboratory and immature stages described in detail (5). Ovipositing females were attracted to odor of *Pinus sylvestris* L. over *P. resinosa* Ait; bud size influenced oviposition, higher on smaller buds (*P. sylvestris*) than on large buds (*P. resinosa*); not able to parasitize larvae in buds protected by needles (4). Only males were collected, needs other host for overwintering and bisexual population (81).

Introduced in Nebraska against *bushnelli* variety, establishment confirmed (121). Occasionally parasitizes ichneumonoid or braconid cocoons, and thus may also be considered a secondary parasite (129). Females were conditioned to associate color with the presence of hosts (associative learning), showed an innate preference for blue over yellow (6). Attractiveness of different flowers and foods to adults studied (83). Pictured in Figure 7a.



*Itoplectis evetriae* Viereck

Literature Record: *Ephialtes evetriae* (Viereck) (88)  
*Itoplectis? evetriae* (124)

Size : Front wing length 4.0 to 8.5 mm (129)

Range : Alaska, Wash., Oreg., Calif., Mont. (104); Ont. (129, 139); Que. (18,129); B. C. (88); Ariz., Wash., Oreg., N. H., Newfoundland, N. B., Mont., Calif. (129); Wisc. (124)

Hosts : *R. buoliana* (18,88,104,124,127,129,139)  
*Evetria* sp. (104)

Annotations : Solitary internal parasite emerging from pupa July 12, 13, 20 in Wisconsin; larva described and illustrated (124).

*Itoplectis quadricingulatus* (Provancher)

Literature Record: *Ephialtes obesus* (Cushman) (88)  
*Itoplectis 4-cingulatus* (Provancher) (104,140)  
*Itoplectis obesus* Cushman (127)

Size : Front wing length 3.5 to 9.0 mm long (129)

Range : Transcontinental (104); B. C. (88)

Hosts : *R. buoliana* (88,104,127,129)

Annotations :

*Itoplectis* sp.

Literature Record:

Size :

Range : Ont. (31,110,139)

Hosts : *R. buoliana* (31,110,139)

Annotations : Adults emerged 4-7 July in Ontario (110).

*Phaeogenes* sp. nr. *epinotiae* Cushman

Literature Record:

Size : Body length 4.3 mm  
Range : Ont. (139)  
Hosts : *R. buoliana* (139)  
Annotations :

*Phaeogenes* sp. nr. *hebrus* (Cresson)

Literature Record:

Size : Body length 9-10 mm (36)  
Range : Ont. (139)  
Hosts : *R. buoliana* (139)  
Annotations :

*Phaeogenes* sp.

Literature Record:

Size :  
Range : Ont. (110)  
Hosts : *R. buoliana* (110)  
Annotations : Adult emerged 7 June in Ontario (110).

*Glypta varipes* Cresson

Literature Record:

- Size : Body length 7 mm
- Range : Mass. (41,46); Mass., N. Y. (114)
- Hosts : *R. frustrana* (41,46,114,127)  
*R. rigidana* (114)
- Annotations : Solitary, internal larval parasite (41); adults emerge in May and June in Massachusetts, one parasite per host, probably two generations, hibernates in cell within host larva (114). Released in Nebraska against *bushnelli* variety, establishment unknown (46).

*Pimplopterus parvus* (Cresson)

Literature Record:

- Size : Body length, ♂ 4.9 mm, ♀ 7.4 mm
- Range : Mass. (114)
- Hosts : *R. buoliana* (114)
- Annotations : Adults emerge in June and early July, one parasite per host, at least two generations per year (114).

*Campoplex frustranae* Cushman

Literature Record:

- Size : Body length, ♀ 5 mm, antennae 3 mm, ovipositor 1.5 mm (42)
- Range : Mass., Pa., Va., Neb. (104); Mass. (114); S. C. (48); Va. (41,42,130,135); N. C. (17); Neb. (135)
- Hosts : *R. frustrana* (17,41,42,46,48,104,114,128,130,135)  
*R. frustrana* var. *bushnelli* (46,135)
- Annotations : Internal larval parasite (41); attacks when larva is young, parasitized larva completes development and pupates, parasite spins its cocoon within the shattered pupal skin of the host (41,46); cocoon is not spun until spring with overwintering brood (46). One of the most abundant parasites (41,48,130). Adults emerge late May and June in Massachusetts, solitary, one generation per year (114). Rearing studies outlined (48).

Introduced in Nebraska against *bushnelli* variety (46, 104,135); two generations per year in Nebraska, overwintering occurs in the ground litter within host pupae (46). Parasite increased rapidly against *bushnelli* variety with parasitism reaching 82%, however, another tip moth variety *R. frustrana* var. *neomexicana* (Dyar), which is not parasitized by this species, increased rapidly and the parasites effectiveness decreased (46).

*Campoplex* sp.

Literature Record:

- Size :
- Range : Que. (18); Ohio (97); Ont. (31,110,139)
- Hosts : *R. buoliana* (18,31,110,139)  
*R. rigidana* (97)
- Annotations : Emergence date in Ontario was 28 June (110).

*Diadegma* sp.

Literature Record: *Horogenes* (18,139)

Size :

Range : Que. (18); Ont. (139)

Hosts : *R. buoliana* (18,139)

Annotations : No specimens of this genus have been found in the U. S. National Museum collection from *Rhyacionia*.

*Pristomerus baumhoferi* Cushman

Literature Record: *Pristomerus* (*Pristomerus*) *baumhoferi* Cushman (128)

Size : Body length, ♀ 5-6.5 mm (43)

Range : Ont., Fla., Ark., Neb., Texas, Colo., Idaho, Nev., Ariz. (104); Neb. (43,128)

Hosts : *R. frustrana* var. *bushnelli* (43,104,128)

Annotations :

*Pristomerus* n. sp.

Literature Record:

Size :

Range : Neb. (66)

Hosts : *R. frustrana* var. *bushnelli* (66)

Annotations :

*Pristomerus* sp.

Literature Record:

Size :  
Range : S. C. (48)  
Hosts : *R. frustrana* (48)  
Annotations :

*Trathala retiniae* (Cresson)

Literature Record: *Zaleptopygus retiniae* (Cresson) (104,128,140)  
*Cremastus* (*Zaleptopygus*) *retiniae* Cresson (38)  
*Cremastus retiniae* Cresson (30,38)

Size : Body length, ♂ about 6.4 mm (30)  
Range : N. Y., Md., D. C., Va. (38,104); N. Y. (30)  
Hosts : *R. rigidana* (104,128)  
(*Retinia*) *Evetria rigidana* (38)  
*Retinia rigidana* (30)  
Annotations :

*Temelucha epagoges* (Cushman)

Literature Record: *Cremastus epagoges* Cushman (41,66,104,114,128,130,140)  
*Cremastus* (*Cremastus*) *epagoges* Cushman (38)

Size : Body length, ♂ 6 mm, antennae 3.5 mm; ♀ 7 mm,  
antennae 4 mm, ovipositor 3 mm (38)  
Range : Va. (41,46,130); Tenn. (38,41); Neb. (46,66); S. C.  
(48); N. J. (114)  
Hosts : *R. frustrana* (41,48,104,128,130)  
*R. frustrana* var. *bushnelli* (46,66,104,128)  
Annotations : Internal larval parasite (41); adults emerge in July;  
one parasite per host; at least two generations (114).



*Temelucha interruptor* (Gravenhorst)

Literature Record: *Cremastus interruptor* Gravenhorst (28,31,45,47,54,86,104,110,115,128,140)  
*Cremastus* (C.) *decoratus* Gravenhorst (38) (misidentification) (104)  
*Cremastus decoratus* (misidentification perpetuated from previous record) (127,128)  
*Cremastus interruptor* Grav. (116)

Size : Body length 6.5-8 mm

Range : Ont., N. Y., Conn., N. J. (104); Ont. (8,31,75,76,86,90,109,110,115,116,139); Que. (18); Conn. (54); Conn., Mass., N. J., N. Y. (46); Conn., N. Y., N. J. (47); Canada (45); N. Y. (38,128)

Hosts : *R. buoliana* (7,8,18,28,31,45,46,47,54,75,76,86,90,104,109,110,115,116,128,139)  
*Evetria buoliana* (38)

Annotations : Internal larval parasite (75); one generation per year; overwinters as first instar larva, development completed in spring; full grown larvae emerge from host larva or pupa to spin delicate cocoon in host larval mine, adults present June and July (46); can withstand low temperatures, however there is the tendency for this species to be reduced in relation to surviving host population because of its preference for the upper crown levels of the infested trees where host mortality is high during severe winters (76).

Hyperparasite *Perilampus tristis* Mayr so destructive that 75% of adults issuing were *Perilampus* instead of primary parasite (45).

Shows preference for buds previously visited by *Orgilus obscurator* and host larvae parasitized by *Orgilus*. Indicates that importing and releasing of *T. interruptor* in North America to assist in control of *R. buoliana* was unwise (8).

Literature summarized (7); larval morphology and life cycle details outlined (75).

Introduced from Europe (104); has never been recovered in substantial numbers (46); established but control value doubtful (90).

*Temelucha evetriae* (Cushman)

- Literature Record: *Cremastus evetriae* Cushman (104,128,140)  
*Cremastus (Cremastus) evetriae* Cushman (38)
- Size : Body length, ♀ 6 mm, antennae 3 mm, ovipositor 2 mm (38)
- Range : Ariz., N. M. (104)
- Hosts : *R. frustrana* var. *bushnelli* (104,128)  
*Evetria bushnelli* (38)
- Annotations :

*Temelucha minor* (Cushman)

- Literature Record: *Cremastus minor* Cushman (104)  
*Cremastus (Cremastus) minor* (38)
- Size : Body length, ♂ 5.5 mm, antennae 4 mm; ♀ 7 mm, ovipositor 2 mm, antennae 4 mm (38)
- Range : Ont. (139), N. J., Pa., D. C., Mich., Ill., Kans. (38); Atlantic to 100° W., mostly Upper Austral Zone (104)
- Hosts : *R. buoliana* (139)
- Annotations :

*Temelucha rhyacioniae* (Cushman)

- Literature Record: *Cremastus rhyacioniae* Cushman (43,104,140)
- Size : Body length, ♀ 6-7.5 mm (43)
- Range : Atlantic to Sask. and S. D. (104); S. D. (43)
- Hosts : *R. frustrana* var. *bushnelli* (43,104)
- Annotations :

*Temelucha* sp.

Literature Record: *Cremastus* sp. (66,97)

Size :

Range : Neb. (66); S. C. (48); Ohio (97); Ont. (139)

Hosts : *R. frustrana* (48)  
*R. frustrana* var. *bushnelli* (66)  
*R. rigidana* (97)  
*R. buoliana* (139)

Annotations : One generation per year (97).

*Atrometus clavipes* (Davis)

Literature Record:

Size : Body length, ♂ 7 mm, antennae 4.5 mm (44)

Range : Ont. (139)

Hosts : *R. buoliana* (139)

Annotations :

*Atrometus evetrivorus* (Rohwer)

Literature Record: *Podogaster evetrivorus* Rohwer (112)

Size : Body length, ♂ 8 mm; ♀ 7.5 mm (112)

Range : N. M. (104, 112)

Hosts : *Rhyacionia* sp. (128)  
*Evetria* sp. (112)

Annotations :

*Atrometus* sp.

Literature Record:

Size :  
Range : Neb. (66); Wisc. (124)  
Hosts : *R. frustrana* var. *bushnelli* (66)  
          *R. buoliana* (124)  
Annotations : Solitary internal pupal parasite; larva described and  
                  illustrated (124).

Superfamily Chalcidoidea

Family Trichogrammatidae

Dowden makes reference to the European *Trichogramma evanescens* Westwood being liberated in Connecticut and New Jersey against *Rhyacionia buoliana* but this was never known to be established (46).

*Trichogramma* sp.

Literature Record:

Size :  
Range : Calif. (119)  
Hosts : *R. zozana* (119)  
Annotations : Egg parasite rarely encountered (119).

*Trichogramma minutum* Riley

Literature Record:

- Size : Body length about 0.3 mm
- Range : Common throughout U. S. and Canada (104); Mich. (70, 94); Mass. (114); Conn. (51,55); Va. (80); Ont. (7, 87); Ga. (141)
- Hosts : *R. adana* (87)  
*R. buoliana* (7,51,55,70,80,94,104,114)  
*R. frustrana* (104)  
*R. sp.* (141)
- Annotations : Cosmopolitan parasite which attacks the eggs of many other insects whose abundance is dependent on other hosts (94); a differential parasitism between pine species with shoot moth eggs (70); number of eggs per host probably one; adults emerge late in July in Massachusetts (114); 4% of *R. buoliana* eggs parasitized in Michigan (94); the relationship of egg density and parasitism (80). Tip moth egg parasitism of 64.5% recorded in Georgia; considered as potentially the most important *Rhyacionia* spp. parasite (141). Doubtful that these egg parasites will ever be important enemies of *R. buoliana* (7). Spiders and ants exert more control on *R. buoliana* than *T. minutum* and some other parasites (77). Pictured in Figure 8f.

Family Eulophidae

*Sympiesis guttatipennis* Girault is recorded as parasitic of *R. buoliana* in Maryland (67) and *Sympiesis* sp. parasitic of *R. frustrana* in South Carolina (48) and Manitoba (89). These citations are considered erroneous; members of the genus *Sympiesis* are well-known parasites of leaf- or pine-needle miners. *Derostenus* sp. from *R. rigidana* in Ohio (97) is also considered a stray probably from a needle miner.

According to B. D. Burks, USDA taxonomist, the record of *Tetrastichus varicornis* (Girault) from *R. frustrana* in Maine and Massachusetts (114, 140) is a result of a misidentification made in 1932.

*Di cladocerus* sp.

Literature Record:

- Size :
- Range : Calif. (82)
- Hosts : *R. pasadenana* (82)
- Annotations :

*Tetrastichus coeruleus* Ashmead

Literature Record:

- Size : Body length, ♂ 1.5 mm; ♀ 1.6-1.8 mm (23)  
Range : S. C. (48)  
Hosts : *R. frustrana* (48)  
Annotations : Secondary parasite.

*Tetrastichus turionum* (Hartig)

Literature Record:

- Size : Body length, ♂ 1-1.4 mm; ♀ 1.1-2 mm (23)  
Range : Mass., N. J., N. Y. (47); Ont. (31,74,90,108,109,139); Canada (7,46); U. S. (7); N. Y. (114); N. Y., Conn., Mass., N. J. (104); Mass., N. J. (46)  
Hosts : *R. buoliana* (7,23,28,31,46,47,74,90,104,108,109,114,139)  
Annotations : Introduced parasite successfully established in the U. S. and Canada. Internal pupal parasite (28,46,74); gregarious (7,67,114); with average of 20 (114) to 23 (7) parasites per host; one generation per year (7,46); full grown larvae overwinter in pupal shell of the host, pupation occurs in the spring; adult females emerge about the time the host larvae are pupating (46). Parasites do not lay on host pupae already parasitized and do not lay more eggs in each host than can reach maturity (7). Lab tests showed 83% overwintering larvae survived — 23° C. (7). Only pupal parasite recommended for release against *R. buoliana* in America; requires no alternate host; apparently a low power of dispersal; *Perilampus tristis* Mayr is a hyperparasite of this species (7). Considered valuable control agent (108). Complete life cycle and morphology are published (74). Established but control value, if any, doubtful (90).



*Tetrastichus longicorpus* (Girault)

Literature Record:

Size : Body length, ♀ 3.3 mm (64)  
Range : N. M. (104)  
Hosts : *R. frustrana* var. *bushnelli* (104)  
Annotations :

*Tetrastichus marylandensis* (Girault)

Literature Record: *Tetrastichus cuneiformis* Gir. (130)  
*Epitetrastichus cuneiformis* Girault (41)  
Size : Body length, ♂ 0.8-1.5 mm; ♀ 1-1.85 mm (23)  
Range : Mass., Md., D. C., Va., Miss., Mo., Ill. (104); Va. (41,130); Mass. (114)  
Hosts : *R. frustrana* (23,41,104,114,130)  
Annotations : Probably not associated in any way with tip moth but rather a midge (41); adults emerge May and June in Massachusetts, one parasite per host, number of generations unknown; possibly a hyperparasite (114).

*Tetrastichus* sp.

Literature Record: *Tetrastichus varicornis* (Girault) (114)  
Size :  
Range : La. (41); S. C. (48); Ohio (97); Maine and Mass. (114)  
Hosts : *R. frustrana* (41,48,114)  
*R. rigidana* (97)  
Annotations : Misidentification of *Tetrastichus varicornis* (Girault) in 1932 included here; adults emerged in May and June, one parasite per host, generations unknown (114). *Tetrastichus hunteri* Crawford pictured in Figure 8b.

*Paraolinx taedae* Miller

Literature Record:

Size : Body length, 1.91 mm (91)  
Range : Ark., N. C. (91)  
Hosts : *R. frustrana* (91)  
Annotations :

*Elachertus pini* Gahan

Literature Record:

Size : Body length, ♂ 1.4 mm; ♀ 1.6 mm (57)  
Range : Va. (57,41); Maine, Vt., Mass., Va., Mich. (104);  
Wisc. (123,124)  
Hosts : *R. frustrana* (41,57,104)  
*R. buoliana* (123,124)  
Annotations : Gregarious external larval parasite (41).

*Elachertus* sp. nr. *pini* Gahan

Literature Record:

Size :  
Range : Ont. (139)  
Hosts : *R. buoliana* (139)  
Annotations : Adults emerged 7 June (139).

*Elachertus* sp. nr. *proteoteratis* Howard

Literature Record:

Size : Body length 1.8 mm  
Range : Ont. (139)  
Hosts : *R. buoliana* (139)  
Annotations : This gregarious, larval parasite emerged 25 April in Ontario (139).

*Hyssopus rhyacioniae* Gahan

Literature Record:

Size : Body length, ♀ 1.3 mm; ♂ smaller (57)  
Range : Va. (41,46,57,104,130); S. C. (48)  
Hosts : *R. frustrana* (41,57,104,130)  
Annotations : A gregarious (41) larval parasite (57); reared from both generations in Virginia (130). Liberated in Nebraska against *R. frustrana* var. *bushnelli* in 1925; not known to be established (46).

*Hyssopus* sp.

Literature Record:

Size :  
Range : W. Va. (67); S. C. (48)  
Hosts : *R. buoliana* (67)  
          *R. frustrana* (48)  
Annotations :

*Hyssopus thymus* Girault

Literature Record: *Hyssopus thymus* (Girault) (41,123)

- Size : Body length, ♀ 0.85 mm (62)
- Range : Conn., Va., Neb., Calif. (104); Va., Neb. (41); Conn. (1,51,52,53,54,55); Mich. (69,94); Ohio (92,96,97); Man. (89); W. Va., Md. (67,81); S. C. (48); Ont. (3,4,31,51,108,139); Va. (46); New England, N. Y., N. J. (114); Wisc. (123,124)
- Hosts : *R. frustrana* (41,46,48,89,104,114)  
*R. rigidana* (97)  
*R. buoliana* (1,3,4,31,51,52,53,54,55,67,69,81,92,94,96,104,108,114,123,124,139)
- Annotations : Gregarious, external parasite of grown larvae (41,54,92,124); several generations per year (2,54); at least two generations per year and a partial third (124,139); paralyzes host before depositing its eggs (3,139); hibernates as pupa in host gallery in bud or shoot (54,114); possibly only one generation; adults emerge May, June and July (114), late May till end of July (139), peak emergence July 10-17 (123); transforms to pupal stage in August and Sept. and develops another generation in shoot moth the following spring (94).

Caused mid-August increase in larval mortality of *R. buoliana* (69). Probably attacks all larval stages; females enter host tunnels, paralyze larvae and deposit one to several eggs on or near host (139). Most abundant parasite (94); accounted for 13-23% mortality in the fall (108). Liberated against *bushnelli* variety in Nebraska in 1925, not known to be established (46). Parasites occurred approximately in equal numbers on the two trees *Pinus resinosa* and *P. sylvestris* infested by shoot moth (4). Commonest in the bottom of trees (81).

Emerged successfully from the same host with *Eurytoma pini* Bugbee, *Habrocytus thyridopterigis* Howard, *Eupelmella vesicularis* (Retzius); larva described and illustrated; number per host 1-86; longevity studies indicate adults can survive an average of 47 days (124).

*Euderus argyresthiae* (Crawford)

Literature Record:

Size : Body length, ♂ 1.8 mm; ♀ 3 mm (34)  
Range : N. Y., Minn., Wash. (104); S. C. (48)  
Hosts : *R. frustrana* (48)  
Annotations :

*Euderus subopacus* (Gahan)

Literature Record: *Secodella subopaca* Gahan (57,130)  
*Secodella subopaca* (Gahan) (41)  
*Secodella subopaea*! Gahan (116)  
Size : Body length, ♂ 1.25 mm; ♀ 1.9 mm (57)  
Range : Va., La. (41); Ont., Va., Ohio, La., Calif. (104);  
Va. (57,130); Ont. (116,139)  
Hosts : *R. frustrana* (41,57,104,130)  
*R. buoliana* (104,116,139)  
Annotations : Solitary external parasite of small larvae (41).

Family Elasmidae

*Elasmus setosiscutellatus* Crawford

Literature Record: *Elasmus setosiscutellum*! Crawford (104)  
Size : Body length, ♂ 1.5 mm; ♀ 2 mm (33)  
Range : Va. (41); Va., La., Texas, Wisc., Neb., Kans. Calif.  
(104); Neb. (66); S. C. (48); Texas, Calif., Wisc.  
La., Kans. (107)  
Hosts : *R. frustrana* (48,104,107)  
*R. frustrana* var. *bushnelli* (66)  
Annotations : Cushman states this parasite was probably reared from  
a midge (41). Secondary parasite.

## Family Encyrtidae

*Ooencyrtus* sp. from *R. frustrana* in Virginia (130), and *Ageniaspis* sp. from *R. pasadenana* in California (82) are considered by B. D. Burks as erroneous parasite citations.

### *Copidosoma geniculatum* (Dalman)

#### Literature Record:

- Size : Body length 1.5 mm
- Range : Mass., N. Y., Conn. (45,104); Mass. (114); Mass., Conn., N. Y. and Pa. (46); Ont. (31,86)
- Hosts : *R. buoliana* (31,45,46,86,104)  
*R. frustrana* (114)
- Annotations : Introduced gregarious parasite of *R. buoliana*; tiny polyembryonic chalcid which completes development about the time shoot moth larvae are full grown; pupation takes place inside the empty host skin; sixteen parasites per host (45). Overwinters in an immature stage with the host larva; one generation per year (46). Parasite identity is questioned for *R. frustrana*; adults emerge in May; probably one generation; gregarious (114).

## Family Eupelmidae

### *Eupelmus cyaniceps amicus* Girault

Literature Record: *Eupelmus cyaniceps* Ashmead (110,123,124)

- Size : Body length, ♀ 3.6 mm; ovipositor 0.08 mm (63)
- Range : N. Y. to Ga. and Ill., Ohio, Ark., N. M. and ? Texas (104); Va. (130); N. C. (17); Ont. (110); Mass. (114); Wisc. (123,124)
- Hosts : *R. frustrana* (17,104,114,130)  
*R. buoliana* (110,123,124)
- Annotations : Adults emerged in Ontario on 24 June (110). In Massachusetts adult emergence was May and June; gregarious; at least two generations per year; hibernation occurs in host larval cavity (114). Evidence suggests this is a secondary parasite through *Exeristes comstockii* (Cresson) (124).



*Eupelmus cyaniceps cyaniceps* Ashmead

Literature Record: *Eupelmus cyaniceps* Ashmead (41,48,67,81)

- Size : Body length, ♀ 3.6 mm; ovipositor 0.08 mm (10)
- Range : Ont. to N. C., Fla., Miss., La., Texas, Ark., Okla., Kans., N. M. (104); W. Va., Md. (67); S. C. (48); Md. (81)
- Hosts : *R. frustrana* (41,48)  
*R. buoliana* (67,81)
- Annotations : Primary or secondary (41); rare larval parasite (81).  
Pictured in Figure 8a.

*Eupelmus* sp.

Literature Record:

- Size :
- Range : S. C. (48)
- Hosts : *R. frustrana* (48)
- Annotations :

*Eupelmella vesicularis* (Retzius)

- Literature Record: *Macroneura vesicularis* (Retzius) (107,124)  
*Macroneura* (= *Eupelmella*) *vesicularis* (124)
- Size : Body length, ♀ 1.25 to 3.2 mm (58)
- Range : Ont. (107,139); Ont. and Maine to Va., Tenn., Colo., Utah, Oreg., Wash. (104); Wisc. (123,124)
- Hosts : *R. buoliana* (107,123,124,139)
- Annotations : One specimen emerged in Ontario on 11 July; since only one specimen was taken from shoot moth material, further raising is necessary to establish its association (139). Secondary parasite. Solitary, external, primary or secondary parasite; *Exeristes comstockii* (Cresson) and *Hyssopus thymus* Girault served as hosts for this secondary pest; larval taxonomy outlined and illustrated (124). Pictured in Figure 8c.

*Encyrtaspis californica* (Ashmead)

Literature Record: *Encyrtaspis californicus* (Ashmead) (60)

Size : Body length, ♀ 3.5 mm (14)

Range : N. M., Calif. (60,104)

Hosts : *Evetria* sp. (60,104)

Annotations : Records in U. S. National Museum indicate 1913 and 1932 collections; not a common species.

Family Perilampidae

*Perilampus canadensis* Crawford (= *Perilampus canadensis canadensis* Crawford) is recorded as a parasite of *R. buoliana* in West Virginia (67) and *Perilampus chrysopae* Crawford has been recorded as a parasite of *R. frustrana* (104,140) and *R. frustrana* var. *bushnelli* in Nebraska (66). According to B. D. Burks these are erroneous since the former attacks Neuroptera and the latter attacks larvae of solitary Aculeata.

*Perilampus fulvicornis* Ashmead

Literature Record: *Perilampus fulvicornis fulvicornis* Ashmead (97,104, 114,140)

Size : Body length, ♂ 2 mm (10); ♂ 1.5-3 mm; ♀ 1.5-3.5 mm (118)

Range : Que. to Fla., west to Calif. and B. C. (104); Maine, N. H., Mass., N. Y., N. J. (114); Ohio (97); S. C. (48); W. Va. (67); Que. (18); Va. (130)

Hosts : *R. frustrana* (48,104,130)  
*R. rigidana* (97,114)  
*R. buoliana* (67)

Annotations : Hyperparasite (18,97) chiefly through *Orgilus obscurator* (Nees) (18); other hosts include *Eurytoma pini* Bugbee or *Campoplex* sp. (97); *Apanteles epinotiae* Viereck (104). Adults emerge July, August and September; one parasite per host; at least two generations per year; hibernates in larval stage (114). Secondary parasite. Pictured in Figure 7b.

*Perilampus hyalinus* Say

Literature Record:

Size : Body length, ♂ 2-4 mm; ♀ 2-5.5 mm (118)  
Range :  
Hosts : ? *Rhyacionia* sp. (107)  
Annotations : Secondary parasite.

*Perilampus tristis* Mayr

Literature Record:

Size : Body length, ♂ 1.75-2.75 mm; ♀ 2-3 mm (118)  
Range : Ont. (104,116)  
Hosts : *R. buoliana* (104,116)  
Annotations : Secondary parasite of *Temelucha interruptor* (Gravenhorst) and *Orgilus obscurator* (Nees); 75% of adults issuing were *Perilampus tristis* Mayr instead of the primary parasites (45). Secondary parasite.

*Perilampus* sp.

Literature Record:

Size :  
Range : Neb., Va. (41)  
Hosts : *R. frustrana* (41)  
*Retinia* sp. (?) (117)  
Annotations : Secondary parasite (41).

Family Torymidae

*Monodontomerus dentipes* (Dalman)

Literature Record:

- Size : Body length, ♂ 2.75 mm; ♀ 3.5 mm, ovipositor 1 mm (59)
- Range : Ont., Que., Maine, N. Y., N. J., Conn., Pa., Ohio, Mich., Idaho (104); Wisc. (79); Ont. (90,139)
- Hosts : *R. buoliana* (90,139)
- Annotations : *Monodontomerus aereus* Walker pictured in Figure 8g.

*Monodontomerus minor* (Ratzeburg)

Literature Record: *Monodontomerus subobsoletus* Gahan (59,104)

- Size : Body length, ♂ 3.1 mm; ♀ 2.75 to 3.4 mm; ovipositor 0.85 to 1.2 mm (59)
- Range : W. Va. (67); Del., N. J., N. Y., B. C. (107); N. Y., N. J., Del. (104)
- Hosts : *R. buoliana* (67)
- Annotations : Emerged from pupa (67). Secondary parasite.

Family Pteromalidae

*Tridymus* sp. is recorded as a parasite of *R. frustrana* in South Carolina (48). B. D. Burks seriously questions *Tridymus* sp. since this genus parasitizes Diptera and a few Hemiptera.

*Catolaccus aeneoviridis* (Girault)

Literature Record:

Size : Body length, ♂ 1.5-2.5 mm; ♀ 2-3 mm (24)  
Range : Va. (130); Que., Ont., Bermuda (79); Mass. to Fla.,  
Texas, Utah and Calif., north to Wisc. (104)  
Hosts : *R. frustrana* (24,104,130)  
Annotations : Secondary parasite.

*Dibrachys cavus* (Walker)

Literature Record:

Size : Body length 1.3-2.5 mm  
Range : Ohio (96)  
Hosts : *R. buoliana* (96)  
Annotations : Secondary parasite. Pictured in Figure 7c.

*Dibrachys* sp.

Literature Record:

Size :  
Range : Va. (130)  
Hosts : *R. frustrana* (130)  
Annotations :

*Habrocytus phycidis* Ashmead

Literature Record:

- Size : Body length, ♀ 3 mm (15)  
Range : S. C. (48)  
Hosts : *R. frustrana* (48)  
Annotations :

*Habrocytus thyridopterigis* Howard

Literature Record:

- Size : Body length 3.4 mm  
Range : Maine, N. H., Conn., Va., N. C., Mo., Ill., Wisc. (104); Maine, N. H., Vt., Mass., Conn., N. Y. and Del. (114); Conn. (55); Ont. (110); Ohio (96,97); S. C. (48); W. Va. (67); N. C. (17); Man. (89); Va. (41); Md. (67,81); Wisc. (123,124)  
Hosts : *R. frustrana* (17,41,48,89,104)  
*R. rigidana* (97,114)  
*R. buoliana* (55,67,81,96,104,110,114,123,124)  
Annotations : Solitary, external parasite of larva; primary and in one case secondary; intermediate hosts *Campoplex frustranae* Cushman (41,104), *Itoplectis conquisitor* (Say) (104); gregarious, external larval parasite (67, 123,124). Liberated in Nebraska against the *bushnelli* variety in 1925, not known to be established (46). Adults emerge June, July, Aug., and Oct., one parasite per host; at least two generations per year; hibernates as immature stage on host in larval case or cell (114). Adult emergence 29 July in Ontario (110). Rare larval parasite (81). Preference for pupae, average of 4 per host individual, shows preference for hosts in lower tree crown, peak emergence in mid-July and early August (123); range of 1-8 per host; *Exeristes comstockii* (Cresson), *Eurytoma pini* Bugbee, and *Hyssopus thymus* Girault serve as secondary hosts; larva described and illustrated (124). Pictured in Figure 7d.

*Habrocytus* sp.

Literature Record:

- Size :
- Range : Neb. (66); Ont. (31,116,139); W. Va. (67); S. C. (48)
- Hosts : *R. frustrana* (48)  
*R. buoliana* (31,67,116,139)  
*R. frustrana* var. *bushnelli* (66)
- Annotations : In Ontario one specimen emerged 21 June and four specimens emerged 3 July from *R. buoliana*; some species of this genus are hyperparasites (139). Spiders and ants exert more control on *R. buoliana* than *Habrocytus* sp. and other parasites (77).

Family Eurytomidae

*Eurytoma tylodermatis* Ashmead (Fig. 8d, 8e) is a misidentification for *Eurytoma pini* Bugbee. The former species is erroneously found in numerous citations. An additional misidentification includes *Eurytoma appendigaster* (Swederus). This was recorded by Sheppard in 1933 (116) and the citation was carried over in several subsequent parasite lists (31,104,110).

All of the above references should refer to *Eurytoma pini* Bugbee.

*Eurytoma* sp.

Literature Record:

- Size :
- Range : Neb. (121); Ont. (110); N. Y. (114)
- Hosts : *R. frustrana* var. *bushnelli* (121)  
*R. rigidana* (114)  
*R. buoliana* (110)
- Annotations : Introduced in Nebraska against *bushnelli* variety, establishment confirmed (121); adults emerged 30 June in Ontario (110); adults emerged during August in N. Y.; one parasite per host; at least two generations per year (114).



*Eurytoma pini* Bugbee

- Literature Record: *Eurytoma appendigaster* (Swederus) (31,110,116)  
*Eurytoma tylodermais* Ashmead (17,53,55,66,92,104,106,  
114,130,140)  
*Eurytoma tylodermais* (Ashmead) (41,96)
- Size : Body length, ♂ 3 mm; ♀ 4.5 mm (21)
- Range : Canada and U. S., from southern Que., Ont., Man., Sask.,  
and B. C., south to Md., Va., Mo., Neb. (21); W. Va.,  
Md. (67,81); S. C. (48); Ohio (96,97); Va. (41,46,130);  
Mich. (94); Ont. (3,31,110,116,139); Neb. (46,66); N. Y.  
(114); N. C. (17); Conn. (53,55,114); Mass. (114);  
eastern U. S. and southern Canada (41); Wisc. (123,124);  
Ont., New England, N. J., Pa., Wisc. (104)
- Hosts : *R. frustrana* (17,21,41,48,53,104,106,107,114,130)  
*R. frustrana* var. *bushnelli* (46,66,106)  
*R. bushnelli* (21)  
*R. rigidana* (21,92,97,107)  
*R. buoliana* (3,21,31,53,55,67,81,92,94,96,104,107,110,  
114,116,123,124,139)  
*Evetria* (=Rhyacionia) *buoliana* (21)  
*Evetria* (=Rhyacionia) *frustrana* (21)
- Annotations : New species previously reported as *Eurytoma tyloder-*  
*mais* Ashmead (21,107) or *Eurytoma appendigaster*  
(Swederus) (31,104,110,116). External larval parasite  
(3,41,55,67,94,139); solitary (94); observations  
indicate this species may be both a secondary and  
multiple parasite (124); probably a secondary parasite  
as it will not oviposit on active shoot moth larvae in  
the laboratory (139); classified a "cleptoparasite" as  
it depends on other parasites to inactivate or  
parasitize host larvae before it lays eggs (3); may  
occasionally act as secondary parasite (21). Adult  
emergence was from early June until late July in  
Ontario (139); emergence date 24-30 June and 3-19 July  
in Ontario (110); adults emerge May, June, and July  
(114); development from egg to adult averaged 28 days  
(21-34) in Wisconsin (124). Common larval clepto-  
parasite (81); probably ovipositing in *Scambus* (S.)  
*hispa* (Harris) or *Exeristes comstockii* (Cresson),  
peak emergence in late July (123); one host is  
*Macrocentrus ancylivorus* Rohwer (104). Liberated in  
Nebraska against the *bushnelli* variety in 1925; not  
known to be established (46); important in the Piedmont  
of South Carolina (48); numerous in Virginia during both  
generations of *R. frustrana* (130); at least two genera-  
tions; hibernates in larval cell (114); description of  
immature stages (3); larval and egg descriptions out-  
lined and illustrated (124).

*Eurytoma* sp. prob. *pini* Bugbee

Literature Record:

Size :  
Range : Ont. (139)  
Hosts : *R. buoliana* (139)  
Annotations :

Family Chalcididae

B. D. Burks considers *Brachymeria molesta* Burks (= *Brachymeria* (*Brachymeria*) *molestae* Burks) (25) as an erroneous *R. frustrana* parasite record from South Carolina (48).

*Haltichella rhyacioniae* Gahan

Literature Record:

Size : Body length, ♂ 2.8 mm; ♀ 3.6 mm (57)  
Range : Mass., Va., Neb. (104); Mass. and N. J. (114); Va. (46,57,130); Ohio (97); S. C. (48); N. C. (17); Mass. (41); Neb. (57)  
Hosts : *R. frustrana* (17,41,48,57,104,114,130)  
*R. frustrana* var. *bushnelli* (57,104)  
*R. rigidana* (97)  
Annotations : Rare as *R. frustrana* parasite because of its small size; pupates in host pupa (41); adults emerge May, June, and July; one parasite per host; two or more generations per year; hibernates in host pupa (114); numerous both first and second broods in Virginia (130); liberated in Nebraska against *bushnelli* variety; not known to be established (46).

*Haltichella xanticles* (Walker)

Literature Record:

- Size : Body length, 2.3-3.8 mm
- Range : Que. to Fla., Ill., Ohio, Kans., Neb. (104); Neb. (121)
- Hosts : *R. frustrana* var. *bushnelli* (121)  
*R. buoliana* (104)
- Annotations : Introduced in Nebraska against the *bushnelli* variety;  
establishment confirmed (121).

*Haltichella* n. sp.

Literature Record:

- Size :
- Range : Neb. (66)
- Hosts : *R. frustrana* var. *bushnelli* (66)
- Annotations :

*Spilochalcis flavopicta* (Cresson)

Literature Record: *Spilochalcis delira* (Cresson) (41,130)

- Size : Body length, ♂ 3.5 mm (22)
- Range : N. Y. to Fla., Texas, Kans, and Ill., Colo., N. M.,  
Ariz., Calif., Oreg. (104); Va. (41,130); S. C. (48);  
N. C. (17)
- Hosts : *R. frustrana* (17,41,48,104,130)  
*Evetria frustrana* (22)
- Annotations : Secondarily parasitic through pupal parasite (41);  
collected from both broods in Virginia (130).

*Spilochalcis leptis* Burks

Literature Record:

Size : Body length, ♂ 2.5-3.5 mm (22)  
Range : S. C. (48); Calif., Nev., Idaho (104)  
Hosts : *R. frustrana* (48)  
Annotations :

*Spilochalcis* sp.

Literature Record:

Size :  
Range : Va. (41)  
Hosts : *R. frustrana* (41)  
Annotations : Secondarily parasitic through pupal parasite (41).

Superfamily Bethyloidea

Family Bethylidae

*Goniozus* is the only genus of this superfamily that has been found to be parasitic on *Rhyacionia*. Pictured in Figure 7e.

*Goniozus columbianus* Ashmead

Literature Record:

Size : Body length, ♂ 1.5-2 mm; ♀ 1.5-2 mm (13)  
Range : Ohio (96); D. C. (13)  
Hosts : *R. buoliana* (96)  
Annotations :

*Goniozus electus* Fouts

Literature Record:

Size : Body length, ♂ 2.1 mm; ♀ 2.3 mm (50)  
Range : La. (50,104); S. C. (48)  
Hosts : *R. frustrana* (48,50,104)  
Annotations :

*Goniozus nr. electus* Fouts

Literature Record:

Size :  
Range : Ohio (96)  
Hosts : *R. buoliana* (96)  
Annotations :

*Goniozus foveolatus* Ashmead

Literature Record:

Size : Body length, ♀ 2.5 to 3 mm (13)  
Range : Ohio (96); Fla. (11)  
Hosts : *R. buoliana* (96)  
Annotations :

*Goniozus longiceps* Kieffer

Literature Record:

- Size : Body length, ♀ 3.5 mm (78)  
Range : La. (41); Neb. (66); Texas (41,78,104)  
Hosts : *R. frustrana* (41)  
          *R. frustrana* var. *bushnelli* (66)  
Annotations : External parasite of larva; probably gregarious on full or nearly full-grown larvae (41).

*Goniozus longinervis* Fouts

Literature Record:

- Size : Body length, ♂ 2.15 mm; ♀ 2.70 mm (50)  
Range : Neb., S. D., Calif. (104); Neb. (50)  
Hosts : *R. frustrana* var. *bushnelli* (50,104)  
Annotations :

*Goniozus* n. sp.

Literature Record:

- Size :  
Range : Mass. (114)  
Hosts : *R. frustrana* (114)  
Annotations : Adults emerged in July; one parasite per host; generations unknown (114).

*Goniozus* sp.

Literature Record:

Size :  
Range : Mass. (114)  
Hosts : *R. buoliana* (114)  
Annotations : Adults emerged in June; one parasite per host;  
generations unknown (114).

Superfamily Proctotrupoidea

Family Platygasteridae

A *Platygaster* sp. was reared from *R. frustrana* infested material from South Carolina (48). This doubtful citation is omitted since most species of this genus parasitize Diptera of the family Cecidomyiidae (104).

Superfamily Cynipoidea

Family Cynipidae

*Pseudoeucoila* (= *Hexamerocera* sp.) sp. was reared from *R. buoliana* infested shoots in Maryland (81). Kulman questions this very rare parasite (probably parasitic of Diptera) so it is therefore omitted.



## ORDER DIPTERA

Superfamilies Mycetophiloidea, Nothyboidea, Muscoidea

Families Sciaridae, Otitidae, Muscidae

The following species are recorded as parasitic of *R. buoliana* from Maryland; *Bradysia* sp. (67), and *Euxesta* prob. *notata* (Wiedemann) (81). In all probability these are scavengers or saprophagic and are erroneous citations. *Coenosia* sp. is a questionable record from *R. rigidana* in Ohio (97).

### Superfamily Chloropoidea

Family Chloropidae

*Hapleginella conicola* (Greene)

Literature Record: *Oscinella conicola* Greene (123,124,139)

Size : Body length 1.5 mm  
Range : Oreg., Calif., Utah, Wisc., Ont., Que., ? Ark. (120);  
Wisc. (123,124); Ont. (139)  
Hosts : *R. buoliana* (123,124,139)  
Annotations : Two individuals emerged from one *R. buoliana* on  
August 11 in Wisconsin (123); role of insect is still  
not adequately clarified (124).

### Superfamily Oestroidea

Family Tachinidae

*Lypha dubia* (Fallén)

Literature Record: *Tachina* (120)

Size : Body length 5.5 mm  
Range : Sweden, Palearctic; introd. Mich., eastern Canada,  
N. Y., Mass., Conn., questionable establishment (120).  
Conn., Mass., N. Y. (46)  
Hosts : *R. buoliana* (45,46)  
Annotations : In 1934 Dowden stated a native species has been deter-  
mined as *Lypha dubia* but it is not known if it is bio-  
logically the same as the European one or not. To  
date the American species had not attacked *R. buoliana*  
(45).

*Lixophaga mediocris* Aldrich

Literature Record:

- Size : Body length 3-3.8 mm (2)
- Range : Va., Ill. to N. J., south to Miss. and Fla. (120);  
N. Y., N. J. (114); Va. (41,130)
- Hosts : *R. frustrana* (2,41,46,48,114,130)  
*R. buoliana* (114)
- Annotations : Internal larval parasite which emerges from the larva and pupates (41). This solitary parasite probably has two generations per year (114). Liberated in Nebraska against *R. frustrana* var. *bushnelli* but it is not known to be established (46). In South Carolina this was the second most abundant parasite of *R. frustrana* (48). Pictured in Figure 7f.

*Lixophaga plumbea* Aldrich

Literature Record:

- Size : Body length 3-3.5 mm
- Range : Va., Utah to Ont. and Conn., south to Ariz. and Fla. (120); Va. (41,130)
- Hosts : *R. frustrana* (2,41,46,130)
- Annotations : Internal larval parasite which emerges from host larva and pupates (41). It is a less abundant species than *Lixophaga mediocris* Aldrich. Introduced in Nebraska against *R. frustrana* var. *bushnelli* but not known to be established (46).

*Lixophaga* sp.

Literature Record:

- Size :
- Range : S. C. (48)
- Hosts : *R. frustrana* (48)
- Annotations : Undoubtedly either *Lixophaga plumbea* or *Lixophaga mediocris*.

*Urophyllopsis retiniae* (Coquillett)

Literature Record: *Admontia retiniae* Coquillett (82)

Size : Body length 4.9 mm

Range : Calif., Oreg. (120); Calif. (82)

Hosts : *R. pasadenana* (82)

Annotations : Most widespread and commonest larval parasite with average of 18-20% parasitism; however, 90% parasitism was not uncommon; parasite cocoons are found in larval burrows; one per host (82).

*Actia nudibasis* Stein

Literature Record:

Size : Body length 5.5 mm

Range : Germany; introduced in Ont., Mass., Conn., not established (120); Conn., Mass. (46); Ont. (86); released in Conn., Mass., Ont., no recoveries reported (7)

Hosts : *R. buoliana* (46,86)

Annotations : This solitary internal larval parasite has been introduced in a number of places but confirmed establishment is lacking. In Europe it overwinters in *Evetria resinella* (L.) and in summer attacks *R. buoliana*. Two generations a year with different hosts suggests the need for an alternate host for successful establishment (7).

*Erynnia tortricis* (Coquillett)

Literature Record:

Size : Body length, ♀ 5.5 mm (32)

Range : Calif., B. C. to Newfoundland, south to Calif., Mexico and Va. (120); Wisc. (124); S. D.

Hosts : *R. frustrana* var. *bushnelli*  
*R. buoliana* (124)

Annotations : Unpublished record for *bushnelli* variety based on specimens in U. S. National Museum collection. Internal larval parasite emerging from pupa of *R. buoliana*; puparium and larva described (124).

*Nemorilla floralis* (Fallén)

Literature Record:

- Size :
- Range : Sweden; introduced in Ont., Ohio, Mass., Conn., questionable establishment (120); New England, N. Y. and N. J. (114)
- Hosts : *R. buoliana* (114)
- Annotations : Adults emerge in late June, July, Sept., Oct.; two or more generations per year; one per host; hibernates as larva in host (114).

*Madremyia saundersii* (Williston)

Literature Record:

- Size :
- Range : New England, B. C. to Newfoundland, south to Calif., Mexico, Ill., Mass. (120); Ont. (139)
- Hosts : *R. buoliana* (139)
- Annotations :

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